The LINE of
PROPORTION or NUMBERS,
Commonly called
Gunters Line,
Made Easie.
By the which may be Measured all
manner of *Superficies* and *Solids*, as *Board,
Glass, Pavement, Timber, Stone,* &c.
ALSO,
How to perform the same by a Line of
Equal Parts, drawn from the Centre
of a Two-Foot-Rule.

Whereunto is added
The Use of the Line of Proportion
Improved : Whereby all manner of *Su-
perficies* and *Solids*, may both exactly and
speedily be Measured, without the help
of Pen or Compasses, by Inspection, look-
ing only upon the Ruler.

The Second Edition corrected, and
somewhat enlarged

By WILLIAM LEYBOURN.

London, Printed by *J. S.* and are to be sold
by *George Sawbridge* living on *Clerken-
well-Green,* 1668.

LICENSED,

Nov. 9.   *Roger L'Eſtrange,*
1666.

'64 — 1713

To the Right Honourable

Sir WILLIAM BOLTON Knight,

Lord Mayor of the City of *London*.

And the Right Worſhipful the Alder-
men of the ſame City.

As alſo to

JOHN AuSTEN

and } Eſquires.

THOMAS NEVILE

Commoners, Appointed by a Com-
mittee of Common-Council to direct
the Admeaſurement of the Ruines.
by the late Fire there.

WILLBAM LEYBOURN,

One of thoſe Employed by Order in the
Survey of thoſe Ruines, Humbly pre-
ſents (with the beſt of his Ser-
vices) this Manual.

Neceſſary for all Builders, and thoſe that
ſhall employ them.
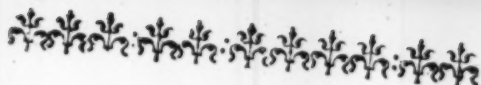
TO THE
READER.

THE Line of Proportion or Numbers, *commonly called* (by *Artificers*) Gunter's Line, *hath been discoursed of by several persons, and variously applyed to divers uses; for when* Mr. Gunter *had brought it from the Tables to a Line, and written some Uses thereof,* Mr. Wingate *added divers Lines of several lengths, thereby to Extract the Square or Cube Roots, without doubling or trebling the distance of the Compasses: After him* Mr. Milbourn *a Yorkshire Gentleman disposed it in a Serpentine or Spiral Line, thereby enlarging the divisions of the Line. Again,* Mr. Seth Partridge *contrived two Rulers to slide*

slide one by the side of the other, having upon them two Lines of one length, which exactly and readily performeth all Operations wrought thereby, very exactly and speedily, without the help of Compasses.

Now whatsoever all the forementioned Contrivances will perform, I have here shewed in this Manual, and so ordered the Line that it will perform the work without Compasses, by Inspection, looking only upon the Ruler. And thereby may be measured (let the Line be of what length soever) not only Board, Glass, Timber and Stone, but also all manner of Hangings, Pavements, Wainscots, Plaistering, Tyling, Brick-work, &c. To all which Uses I have particularly applied it, as will appear by several Instances in all the forementioned particulars; and the rather, because this Treatise may be beneficial and usefull as well to Gentlemen and others (who at this time may
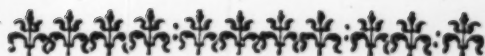
A 3   have

have more than ordinary occasion to make use thereof, in the Re-building of the Renowned City of London,) *as to Artificers themselves, for whose sakes chiefly it was intended.*

Vale.

How

How to Meaſure.

Board and Timber

BY THE

Carpenters PLAIN RULE.

ALL manner of Superficial and Solid Meaſures may be meaſured the moſt abſolute and artificial waies that are yet known by the Precepts and Examples in this Book delivered : But although every Capacity may not attain to the knowledge and underſtanding thereof, I thought good here to inſert the Uſe of that Rule which is commonly made and ſold, and which every Ar-

A 4   tificer

tificer continually carries about him.

Its Description.

1. Of the FORE-SIDE.

It confifteth of two flat fides, one
of which towards either edge there-
of, is divided into 24 equal parts
called Inches, and numbred by 1,
2, 3, 4, and fo forth to 24 at the end
thereof: Every one of the parts or
Inches is again divided into two equal
parts by Lines about half the length
of the other, reprefenting half Inch-
es ; and every of thefe half Inches is
divided into two other equal parts,
called quarters of Inches ; and each
of thofe again into two other equal
parts, called half quarters of Inches :
So that each Inch is divided into eight
equal parts, reprefenting Inches,
Halves, Quarters, and Half-quarters.

Both

Both the edges on the one side of the Rule are thus divided and numbred, only where 24 stands at one end of the Line on one edge, there 1 stands on the other edge; so that which end of the Rule soever you measure with, you may count your number of Inches and parts right, without turning of the Rule.

II. *Of the BACK-SIDE.*

On the other side of the Rule you have two other Lines or Scales drawn near to the edges of the same side ; one is called the *Line of Board-Measure*, the other the *Line of Timber-Measure.* At the beginning of either of these Lines you have a little Table of Figures, the one for *Board*, the other for *Timber* or *Stone.*

The Line or Scale of *Board-Measure* begins at 6 towards your left hand, and so goes on to 36, ending

juſt 4 Inches ſhort of the other end of the Rule; but ſometimes this Line is continued vp to 100, but not often, and then it goes nearer to the end of the Rule, namely, to within an Inch and a half of the end thereof. At the beginning of this Line there is a ſmall Table from 1 to 6 Inches, which ſhews (in Figures) the quantity of the length of a Foot of any Board from one Inch broad to 6 Inches broad, and then the diviſions ſupply the greater bredths.

On the other edge, on the ſame ſide you have the Line or Scale of Timber-meaſure. This Scale begins at 8 and an half, and ſo goes on (by diviſions) to 36, towards the other end of the Ruler, namely, 36 ending within almoſt an Inch and half of the Rules end. To this Scale alſo there belongeth a Table, which ſtandeth at the beginning of the Line, and goes from 1 Inch to 8 Inches, and
gives

gives the quantity of the length of a
Foot of any Timber under 8 Inches
square in Figures, as the other did for
Board from 1 to 6 : And these are
called the *Tables of Under-measure.*

The Table for

UNDER-BOARD-MEASURE.

1	2	3	4	5	6
12	6	4	3	2	2
0	0	0	0	4	0

The Table for

UNDER-TIMBER-MEASURE.

1	2	3	4	5	6	7	8
144	36	16	9	5	4	2	2
0	0	0	0	9	0	11	3

Thus much for the Description of
the

the Lines upon the Carpenters plain
Rule: Now for

Their Use.

I. *Of the* Fore-side, *or side of*
Inches.

This side is only to measure the
length and breadth of any thing to be
measured, in Inches and parts; the
manner of doing whereof is natural to
every man; for, taking the Rule in
the left hand, apply it to the thing to
be measured, so have you the length,
breadth, or thickness of the thing de-
sired. But,

H. *Of*

II. *Of the* Backside.

and,

I. *Of the Line of* Board-meafure.

PROB. 1.

*The breadth of any Board being
given, to finde how much there-
of in length will make a Foot
fquare.*

Look for the number of Inches that
your Board (or Glafs) is broad, in the
Line of Board-meafure; and the num-
ber of Inches and parts of an Inch
which ftand againft that on the other
fide of your Rule, is the quantity of
Inches that will make a Foot fquare of
that Board or Glafs, or what other
thing foever it be to be meafured.

Example

Example 1. *There is a Board or Plank that is 9 Inches broad, how much of that in length will make a Foot square?*

Look for 9 Inches upon the Line of Board-meaſure (which you ſhall finde at the Figure 9 upon the ſame Line,) and juſt againſt that, on the other ſide of your Rule you ſhall finde 16 Inches, which ſhews that every 16 Inches of that piece in length, will make a Foot ſquare.

Example 2. *A Pane of Glaſs is 22 Inches broad, how much thereof in length will make a Foot ſquare?*

Look for 22 Inches in the Line of Board-meaſure, and right againſt it (on the other ſide of your Rule) you ſhall finde 6 Inches and almoſt an half; and ſo much in length of that breadth will make a Foot ſquare.

Example

Example 3. *If any plain Superficies be* 30 *Inches broad, how much thereof in length will make a Foot square ?*

Seek for 30 Inches in the Line of Board-measure, and right against it on the other side of the Rule, you shall finde 4 Inches and $\frac{4}{5}$, that is, 4 Inches and 4 fifth parts of an Inch.

Example 4. *If a Board be* 9 *Inches and an half broad, how much thereof in length will make a Foot square ?*

Seek 9 Inches and an half in the Line of Board-measure, and against that on the other side of the Rule, you shall finde 15 Inches and about one sixth part of an Inch, to make a Foot square.

¶ NOTE. All these Examples might be performed otherwise by the Line; for if you take
the

Rule in your left hand, and apply the
end thereof noted with 36 to the end
of the Superficies, the other edge of
the Superficies will shew how many
Inches, Halves and Quarters will
make a Foot square. This needs no
Example.

PROB. 2.

The length and bredth of a Super-
ficies being given, to finde how many
Square Feet are therein contain-
ed ?

By any of the waies (before taught)
finde how much of the bredth gi-
ven will make a Foot square; then
run that length from one of the ends
of the Superficies as often as you can,
and so many square feet is there in that
Superficies.

Example.

Example. *A Board is 9 Inches broad and 15 Foot long, how many square Feet are therein contained ?*

By the first Example you finde that at 9 Inches broad, 16 Inches in length do make a Foot; wherefore take 16 Inches of your Rule, and run that length along the Board from one end thereof, and you shall finde that length to be contained in the Board of 15 Foot long, 11 times and 4 Inches over, which is $\frac{1}{4}$ of a Foot; so that the Board of 15 Foot long and 9 Inches broad, contains 11 Foot and one quarter: The like of any other.

II. *Of the Line of* Timber-measue.

PROB. 1.
The Square of any piece of Timber at the end thereof being given, to finde how much of that piece in length shall make a Foot solid?

The

The use of the Line of Timber-measure is in all respects the same as that of Board-measure; for knowing the square of your piece of Timber at the end thereof, you have no more to do than to look for the quantity of the Square thereof in the Line of Timber-measure, and right against it on the other side of the Rule, you have the quantity of Inches that will make a Foot solid of that piece.

Example 1. *A piece of Timber is 10 Inches square, how much thereof in length will make a Foot solid ?*

Look for 10 Inches in the Line of Timber-measure, and right against it on the other side of the Rule, you shall finde 17 Inches and somewhat above a quarter of an Inch; and so much of that piece in length will make a Foot solid.

Example

Example 2. *If the Square of a piece of Timber be 21 Inches, how much thereof in length will make a Foot solid?*

Seek 21 Inches in the Line of Timber-measure, and against it you shall finde on the other side of the Rule, almost 4 Inches; and so much in length will make a solid Foot of Timber.

Note 1. If Timber be broader at one end than at the other, the usual way is to add both ends together, and take half thereof for the true square; but if the difference be very much, this way is erroneous, though for the most part practised.

Note 2. Also for Round Timber, the usual way is to girt it about the middle with a String, and take a fourth part thereof for the Square; this also is erroneous: Therefore for such as

desire

desire curiosity and exactness, let them repair to the Rules in this Book delivered for that purpose, where they may receive ample satisfaction.

Concerning the Tables at the beginning of the Lines of Board and Timber-Measure.

The Table of Board-Measure gives the length of a Foot square of any Board under 6 Inches broad; therefore by the Table there set you may finde that

			Foot.	In.	parts.	
If a Board be	1		12	0	0	
	2		6	0	0	will
	3	Inches	4	0	0	make
	4	broad	3	0	0	a foot
	5		2	4	5	square.
	6		2	0	0	

By this small Table you may see, that a Board of 4 Inches broad will require 3 Foot thereof in length to

make

make a Foot square.——Also, a Board
of 5 Inches broad will require 2 Foot
4 Inches and 4 fifth parts of an Inch.

The Table of Timber-measure
gives the length of a Foot solid of any
piece of Timber or Stone whose square
is under 8 Inches : Wherefore by the
Table at the beginning of the Line of
Timber-measure you may finde that

If a piece of Timber be	Inches square			
1		256	0	0
2		36	0	0
3		16	0	0
4		9	0	0	will make a Foot solid.
5		5	9	0
6		4	0	
7		2	11	0
8		2	3	0

By this Table (which is the same in
effect with that which standeth at the
end of the Line of Timber-measure)
you may see that a piece of Timber
that is 4 Inches square requires 9
Foot in length to make a solid Foot :
Also, a piece of 5 Inches square, re-
quires

quires 5 Foot 9 Inches and $\frac{7}{10}$ parts of an Inch to make a solid Foot: And so of the rest.

But because these Tables go only to whole Inches, I have here added two Tables, one for Board, the other for Timber; the Table for Board, from one quarter of an Inch to 6 Inches in bredth; and the Table for Timber, from 2 Inches square to 8 Inches, by Inches, Halves and Quarters.

The Tables follow.

The

The Table for Board-Measure.

Inches & qu.		feet.	in.	10 par.	Inches & qu.		feet.	in.	10 par.
	1	48	0	0	III.	0	4	0	0
	2	24	0	0		1	3	8	3
	3	16	0	0		2	3	5	1
I.	0	12	0	0		3	3	2	4
	1	9	7	2	IV.	0	3	0	0
	2	8	0	0		1	2	9	9
	3	6	10	2		2	2	8	0
II.	0	6	0	0		3	2	6	3
	1	5	4	0	V.	0	2	4	8
	2	4	9	6		1	2	3	4
	3	4	4	4		2	2	2	2
III.	0	4	0	0		3	2	1	0

The Table for Timber-measure.

II.	0	36	0	0	V.	0	5	9	1
	1	28	4	3		1	5	2	7
	2	23	0	4		2	4	9	1
	3	19	0	3		3	4	4	2
III.	0	16	0	0	VI.	0	4	0	0
	1	13	7	6		1	3	4	2
	2	11	9	1		2	3	4	9
	3	10	1	8		3	3	1	9
IV.	0	9	0	0	VII.	0	2	11	2
	1	7	11	6		1	2	8	1
	2	7	1	3		2	2	6	7
	3	6	4	6		3	2	4	7

Præmonition.

IF any Gentleman, Artificer or other Person, have a desire to be further instructed in the Uses of this Line of Proportion; In any kinde of Measuring, or in any of the Sciences Mathematical : Or would have any quantity of Stone or Timber measured, either Rough or Squared : Or any Building either for the Brick-layers, Carpenters, Masons, Plaisterers, Joyners, Glasiers or Painters Work: Or their Ground or Foundations for Building in *London* laid out : Or Land in the Countrey Surveyed. The Author hereof will be ready to undertake the performance thereof.

You may hear of him at the House
of Mr. Walter Hayes, at the
Cross-Daggers in Moor-fields,
next door to the Popes-Head-
Tavern.
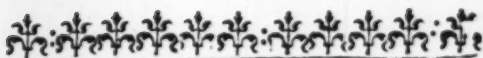
The

THE

Line of Proportion (or Numbers)

Commonly called

Gunters *Line*

Made Easie.

Hat this Line is, and how to make it, is beſt known to thoſe who make Mathematical Inſtruments ; but the uſes of it are ſo general, that all ſorts of men of what faculty ſoever, may apply it to his particular uſe, though it more immediately and particularly concerns ſuch Artificers whoſe employment conſiſts in Menſuration:

B   as

as *Carpenters*, *Joyners*, *Masons*, *Bricklayers*, *Painters*, *Glasiers*, and such like; for that all kind of mensurations, either *SUPERFICIAL*; as *Board*, *Glass*, *Pavement*, *Tyling*, *&c.* Or *SOLID*, as *Timber*, *Stone*, *Pillars*, *Pyramids*, *&c.* are by this Line, most easily, speedily, and exactly performed: For, whatsoever thing concerning measure, that may be performed by Arithmetick, this Line will do exactly, and much sooner; as by the working of the several Rules in Arithmetick, by this Line shall be plainly made appear.

CHAP. I.

NUMERATION upon the Line.

BEfore I shew you how to number upon the Line, it will be necessary to let you understand how the
Line

Line is divided and numbred, as also, what those divisions and numbers set to them upon the Ruler, do signifie.

Know therefore, that the Line of numbers begins at the Figure One, and so proceeds successively from 1 to 2, 3, 4, 5, 6, 7, 8, 9. and then on farther, by 1, 2, 3, 4, 5, 6, 7, 8, 9, to 10. at the end of the line.

The first 1. which standeth at the beginning of the line, representeth the *One tenth part* of any Unite or Integer, as One tenth part of a Foot, One tenth part of a Yard, Ell, Perch, Mile, &c. Or it may signifie One tenth of a Year, Moneth, Hour, &c. Or the one tenth of a Pound, Shilling, or Penny, &c. Or the one tenth part of any thing either in Number, Weight, Measure, Time, or the like. The Figure 2. signifies two tenth parts of any thing. The figure 3. three tenth parts. The figure 4. four tenth

B 2   parts,

parts, &c. till you come to the second 1. which standeth in the middle of the line, which 1. signifieth One whole Unite or Integer, as One whole Foot, Yard, Perch, &c.

Now the other intermediate divisions, those which stand between the figures 1 and 2 (which are in number ten) do represent (each of them) one hundred part of one Unite or Integer; so the first division beyond the figure 1, represents 11 hundred parts of the Integer, the second division, 12 hundred parts of the Integer, and so on; the figure 2 representing 20 hundred parts of the Integer, and the next division beyond 2 is 21 hundred parts, and so on till you come to the figure 1 in the middle of the line, which representeth one whole Integer. The figure 2 signifieth two whole Integers; the figure 3, three whole Integers, and so on till you come to 10 at the end of the line, which signifieth ten whole In-

Integers: and the intermediate divisions which stand between 1 and 2 in the middle of the line are (every of them) tenth parts of the Integer. So the Rule contains 10 whole Integers, every of which is divided into 10 parts.

But if upon the line you would count numbers of more places than two, (which are all numbers above 10) then the 1 which is at the beginning of the line, must be accounted one Integer; and the 1 in the middle of the line, ten Integers; and the 10 at the end will be 100 Integers.

But yet farther, if upon the Line you would express numbers of more places than three (which are all numbers above 100.) Then the 1 at the beginning of the line, is to be accounted ten Integers, the 1 in the middle a hundred Integers, and the 10 at the end of the line 1000 Integers.

B 3   And

And if you proceed yet farther ; then the 1 at the beginning muſt be accounted for a hundred Integers, that in the middle a thouſand, and the 10 at the end of the line for 10000, ten thouſand Integers.

In this manner you might proceed farther, by counting the firſt 1 for 1000, 10000, &c. Integers, but to four places is ſufficient, which by a Rule of a competent length (as of two Foot) any queſtion concerning meaſuring, may be by one exactly e-nough performed.

The Diviſions and Numbers on the line being thus explained, it reſteth now to ſhew you how to finde that point upon the line which ſhall re-preſent any number propoſed, and that I ſhall ſhew you in theſe Propo-ſitions following, which may fitly be called.

NUMERATION.

PROP.

PROP. I.

A whole number consisting of two, three, or four places, being given ; to finde the point upon the Line, which representeth the same.

NOTE, Let your number given be of how many places soever ; for the first figure of your number, you must take the same figure upon the Line : For the second figure in your number, take the number thereof on the grand (or larger) intermediate divisions on the Line : For the third figure in your number, take the number thereof on the smaller intermediate divisions on the line. And for your fourth figure, you must finde its place by estimation.

Example I. *Let it be required to finde the place of* 15 *upon the Line.* For your first figure 1, count the 1 in

B 4   the

the middle of the Line, then for the 5, which is your second figure, count five of the grand (or larger) intermediate divisions upon the line, and that point is the very place upon the line representing 15.

Note, that every fifth of the grand intermediate divisions, is drawn forth with a longer line than the rest for ease in counting.

Again, *To finde the place upon the Line representing* 37. For your first figure 3, count the figure 3 upon the Line, then for the 7, count 7 of the intermediate divisions, and that point is the place upon the Rule representing 37.

Example 2. *Let it be required to finde the place of* 134 *upon the line.* For your first figure 1, count 1 upon the line ; for your second figure 3, count three of the grand divisions ; and for the third figure 4, count 4 of the smallest intermediate divisions, and that very point is the place upon

upon the Line reprefenting 134.

Again, *To finde the place reprefen-*
ting 308. For your firft figure 3,
count the 3 upon the Line ; for your
fecond figure 0 (which is a Cipher)
count none of the grand divifions ;
but for your laft figure 8, count 8 of
the intermediate divifions, and that
point fhall be the place upon the line
reprefenting 308.

Example 3. *Let it be required to*
finde the place of 1350. For your
firft figure 1, take 1 on the middle
of the Line : For your fecond figure
3, take the figure 3 upon the line up-
wards ; for the 5, count five of the
grand intermediate divifions, and that
is the place of 1350.

Again, *To finde the place of* 1626.
For your firft figure 1, count the 1
on the middle of the Line ; for your
fecond figure 6, count the figure 6
upon the line upwards ; then for your
third figure 2, count two of the

B 5   grand

grand divisions; and for your last figure 6, estimate six tenth parts of the next grand division (which is something more than half the distance, because 6 is more than half 10,) and that is the point upon the line representing 1626.

Note, By these Examples last mentioned, you may perceive that the figures 1,2,3,4,5,6,7, 8, 9, do sometimes signifie themselves only, sometimes 10.20. 30, &c. sometimes 100. 200. 300. times themselves, &c. as the work performed thereby shall require. The first figure of every number is alwaies that which is here set down, and the rest of the figures are to be supplyed according as the nature of the Question shall require.

And by this variation and change of the powers of these numbers, from 1 to 10, or 100 or 1000, any proportion either Arithmetical or Geometrical may be wrought. One
whereof

whereof I will infert for your better
exercife of numbring on the Rule ; by
the often practice whereof, you will
finde the work facile and delightfull,
which fhall be this following.

PROP. 2.

Having two numbers given, to finde as
many more, as you pleafe, which
fhall be in continual proportion one
to the other, as the two numbers gi-
ven were.

FOr the working of this propofiti-
on, this is *THE RULE.*
Place one Foot of the Compaffes in
the firft given number on the line, and
extend the other Foot to the fecond
given number, then may you turn
the Compaffes from that fecond num-
ber to a third, from that third to a
fourth, from that fourth to a fifth, a
fixth, a feventh, &c. to what number
of places you pleafe.   *Ex-*

Example 1. *Let the two given numbers be* 2 *and* 4. Place one Foot of your Compasses in 2, and extend the other Foot to 4, then that Foot which now standeth in 2, being turned about, will reach to 8, and from 8 to 16, from 16 to 32, from 32 to 64, from 64 to 128.

But when your Compasses stand in 64, if you turn them about yet farther, they will fall beyond the end of the line, wherefore you must place one Foot in some other, 64 nearer the beginning of the line, and then the other Foot will reach to 128, and from 128 to 256, and from 256 to 512, and from 512 to 1024, but here it will go off your line again, whereof (as before) you must chuse another 512 nearer the beginning of the line, and there placing your Compasses, they will reach to 1024, from 1024 to 2048, from 2048 to 4096, &c.

Example 2.

Example 2. *But if the given num-*
bers were 10 *and* 9 *decreasing,* then
place one Foot in 10 at the end of
the line, and extend the other down-
wards to 9, the same extent will reach
still backwards to 8. 1 (or $8\frac{1}{10}$) and
from 8. 1 to 7. 29, and still backwards
from 7. 29 to 6. 56.

Likewise, if the two first numbers
had been as 1 to 9, the third propor-
tional would have been 81, the fourth
729, and the fifth 656, with the same
extent of the Compasses.

Again :

Let the two numbers be 10 *and* 12,
place one Foot in 10, and extend the
other to 12, that extent will reach
from 12 to 14. 4, and from thence to
17. 28.

But if the numbers were 1 and 12,
then the third proportional would be
144, and the fourth 1728, and all
with the same extent of the Com-
passes.

CHAP.

CHAP. II.

MULTIPLICATION by the Line.

IN Multiplication, the Proportion is this :

As 1 upon the Line,

Is to one of the number to be mul-
tiplyed :

So is the other of the numbers to be
multiplyed

To the Product of them: Which is
the number sought.

Example 1. *Let it be required to
multiply* 5 *by* 7. The proportion
is ;

As 1: to 5 : : so is 7: to 35.
Therefore

Set one Foot of your Compasses in
1, and extend the other Foot to 5 ;
with that extent of the Compasses,
place

place one Foot in 7, and the other Foot will fall upon 35, which is the Product.

Example 2. *Let it be required to multiply* 32 *by* 9. The Proportion is ;

As 1 : to 9 : : so 32 : to 288.

Set one Foot in 1, and extend the other Foot to 9, that same extent will reach from 32 to 288, which is the product or sum of 32, being multiplyed by 9.

Otherwise

Set one Foot in 1, and extend the other to 32, the same extent will reach from 9 to 288, as before.

Example 3. *Let it be required to multiply* 8 $\frac{75}{100}$ *by* 5 $\frac{45}{100}$. The Analogie or Proportion is ;

As 1 : to 8.75 : : so 6.45 : to 56.44. *fere*.

Set one Foot in 1, and extend the other to 8. 75, the same extent applyed forward upon the line, will reach from 6. 45 to 56. 44. *fere*.

Or

Or if you set one Foot in 1, and extend the other to 6. 45 : The same extent will reach from 8. 75 to 56. 44, almost (namely to 43 ¾) as before.

CHAP. III.

DIVISION by the Line.

IN Division three things are to be minded, *viz.*

The {
> *Dividend*, or number to be divided.
> *Divisor*, the number by which the Dividend is divided.
> *Quotient*, which is the number sought.

And so often as the Divisor is contained in the *Dividend*, so often doth the *Quotient* contain *Unity*.

For the working of *Division*, this is the Analogie.

As

As the Divisor
 is to Unity, or 1.
So is the Dividend
 to the Quotient.

Example 1. *Let it be required to divide* 35 *by* 7. The Proportion is ;

As 7 : to 1 : : so 35 : to 5.

Set one Foot of the Compasses in 7, and extend the other Foot downwards to one ; that same extent will reach from 35, downwards, to 5, which is the Quotient, and so many times is 7 contained in 35.

Otherwise

Extend the Compasses upwards from 7 to 35, that same extent will reach, upwards, from 1 to 5, as before.

Example 2. *Let it be required to divide* 288 *by* 32. The Proportion is ;

As 32 : to 1 : : so 288 : to 9.

Extend

Extend the Compasses downwards from 32 to 1, that same extent will reach, downwards, from 288 to 9, which is the Quotient.

Or, extend the Compasses upwards from 32 to 288; the same extent will reach, upwards, from 1 to 9. as before.

Example 3. *Let it be required to divide* 56. 44 *by* 8. 75. The Proportion is ;

As 8.75: to 1:: so 56.44: to 6.45.

Extend the Compasses downwards from 8. 75 to 1, the same extent will reach, downwards, from 56. 44 to 6: 45.

Or, extend them upwards from 8. 75, to 56. 44, the same will reach, upwards, from 1 to 6. 45. as before.

Note this in *Division*, That so many times as the *Divisor* may be orderly set under the *Dividend* in Arithmetical Work, so many places

places of figures shall be in the *Quotient* of your *Division*: As if 347 85 were to be divided by 75, the *Quotient* shall consist of three figures only, namely of 463, because 75 can be but three times set orderly under 34785 in Arithmetical operation.

CHAP. IV.

The GOLDEN-RULE Direct, by the Line.

THis Rule may well be termed the *Golden Rule*, it being the most usefull of all others; for having three numbers given, you may, by it, finde a fourth in proportion to them, as by divers Examples following shall be made plain. And this Rule is performed upon the Line, with the like ease and exactness, as any of those

be-

before mentioned : And for the work-
ing of it upon the Line, that is, the
general Analogie or Proportion.

As the first number given,
  Is to the second number given;
So is the third number given,
  To the fourth number required.

Or

As the first number given,
  Is to the third number given ;
So is the second number given,
  To the fourth number sought.

Wherefore

Alwaies, *Extend the Compasses
from the first number to the se-
cond, and that distance or extent,
applyed, the same way, upon the
Line, shall reach from the third,
to the fourth number required.*

Or otherwise, *Extend the Com-
passes from the first number to the
third, and that extent, applyed
the same way, shall also reach
from the second to the fourth.*

Either

Either of these waies will effect the same thing, as by Examples following shall be made appear.

And it is necessary thus to vary the proportion, sometimes, to avoid the opening of the Compasses too wide ; for when the Compasses are opened to a very large extent, you can neither take off any distance exactly, nor give so good an estimate of any parts required, as you may do when they are opened to a lesser distance : But this you will finde out best by practice; and therefore I will now proceed to Examples.

Example 1. *If 45 yards of Cloth, cost 30 pound, what will 84 yards cost at the same rate?*

As 45 : to 30 : : so 84 : to 56.

Extend the Compasses downward from 45 to 30, that extent will reach downward from 84 to 56 l. the price of 84 yards.

Or

Or, extend the Compasses upward
from 45 to 84, the same will reach
from 30 to 56, as before.

Example 2. *If 26 Acres of Land
be worth 64 l. a year; what is 36 Acres
of the like Land worth by the year?*

As 26 : to 64 : : so 36 : to 88. 615.

Extend the Compasses from 26 to
64, the same extent will reach from
36 to 88 $\frac{615}{1000}$ parts (which is about
12 s. 3 d. 2 q.) and so much is 36
Acres of the like Land worth by the
year.

Example 3. *If 100 l. yield 6 l.
Interest for one year, or 12 moneths,
what shall 75 l. yield?*

As 100 : to 6 : : so 75 : to 4. 50.

Extend the Compasses from 100
to 6, the same extent will reach from
75 to 4. 50. (or 4 $\frac{1}{2}$) which is 4 l.
10 s. and so much will 75 l. yield in-
terest in the year.

Example 4. *If 75 l. yield 4 l. 10 s.
interest for one year, or 12 moneths,
what will 100 l. yield?*

As

As 75 : to 4. 50 : : so 100 : to 6.

Extend the Compasses downwards from 75 to 4. 50, the same extent will reach from 100 to 6, and such interest will 100 l. yield.

Many other Questions might be added, but the Rule (and manner of working it) is so plain, that it needs them not ; and so general, that he which can resolve one, may as well resolve any other, and therefore I shall say no more of it in this place..

CHAP. V.

The *GOLDEN-RULE* Reverse, *by the Line.*

IN this reverse or backward Rule of Three, this note is specially to be observed, That, *If the third number be greater than the first, then will*
the

the fourth number be less than the second. And on the contrary, if the third number be less than the first, then the fourth number will be greater than the second. As by Examples will appear,

Example 1. *If* 12 *Workmen, do any piece of Work in* 8 *daies, how many Workmen shall do the same piece of Work in* 2 *daies?*

It is here to be noted, That in this Question 12 is not the first number (though it be first named) but 2 ; for the middlemost term of the three must be of the same kind with the fourth number which is to be sought ; as in this Example it is Men, therefore 12 (which are men) must stand in the middle, or second place, because the fourth number which is to be sought, is also Men : And therefore the numbers will stand thus,

daies,

daies   men   daies
2,   12,   8.

For, if 8 daies require 12 men, then 2 daies (which is but a fourth part of 8 daies) shall require four times 12 men, that is, 48 men.

For here, *Lefs* requires *More*; that is, *lefs Time, more Hands*, and hence the Work is contrary to the direct Rule: Wherefore to effect it,

Extend the Compaffes from 2 to 8, the fame extent will reach from 12 (the contrary way on the Line) to 48, which is the number of men that will effect the fame piece of work in two daies.

Example 2. *If one Clofe will graze 21 Horfes for 6 weeks, how many Horfes will the fame Clofe graze for 7 weeks?*

Extend the Compaffes from 6 to 7, (for you muft alwaies extend your Compaffes to numbers of one kind or denomination, as here 6 and 7 are

C   both

both Horses)the same extent will reach
from 21 backward to 18, and so many
Horses will the same Close graze for 7
weeks.

CHAP. VI.

Of *DUPLICATE PRO-*
PORTION by the Line.

Duplicate proportion, is such a
proportion as is between Lines
and Superficies, or between Superficies, and Lines.

I. *Of the proportion of LINES
to SUPERFICIES.*

In this Case, extend the Compasses
from the first to the second number of
the same denomination, that same extent (being doubled) shall give the
distance from the third number unto
the fourth.

Example

Example 1. *If the Diameter of a Circle be* 14 *Inches, and the Area, or content thereof be* 154 *Inches, what will be the content of another Circle, whose Diameter is* 28 *Inches ?*

Extend the Compasses from 14 to 28, that extent doubled, will reach from 154, to 616; for first it will reach from 154 to 308, and from thence to 616, and that is the Area or Content of a Circle whose Diameter is 28.

Example 2. *If a piece of Land that is* 20 *Pole square, be worth* 30 *pounds ; what is a piece of Land of the same goodness worth that is* 35 *Pole square ?*

Extend the Compasses from 20 to 35, that extent doubled, will reach from 30 to 91. 8, that is, 91 pound $\frac{8}{10}$ of a pound, which is 16 shillings, and so much is such a piece of Land worth.

C 2　　　　II. *Of*

II. *Of the Proportion of SUPER-FICIES to LINES.*

In this Case, *Extend the Compasses unto the half of the distance between the two numbers of the same denomination; that same extent shall reach from the third number to the fourth required.*

Example 1. *Let there be two Circles given, the Area or Content of the one being* 154, *and its Diameter* 14: *The Area of the other Circle is* 616, *what is the length of its Diameter?*

Upon your Line, divide the distance between 154 and 616, into two equal parts, then with that distance set one Foot in 14, and the other shall fall upon 28, which is the length of the Diameter of the other Circle, whose Area is 616.

Example 2. *There is a piece of Land containing* 20 *Pole square worth* 30 *pounds, there is another piece worth* 91 *pounds* 16 *s. how many Pole square ought*

ought that piece to contain?

Take with your Compasses half the distance between 30 *l.* and 91 *l.* 16 *s.* Then set one foot in 20 pole, and the other foot will reach to 35 Pole, and so many Pole square must the Land be that is worth 91 *l.* 16 *s.*

CHAP. VII.

Of TRIPLICATE PRO-PORTION, by the Line.

TRiplicate proportion, is such a proportion as is between *Lines* and *Solids*, or between *Solids* and *Lines.*

I. *Of the Proportion between* LINES *and* SOLIDS.

In this Case, *Extend the Compasses from the first number to the second of the same denomination,*

C 3   *that*

that extent (being tripled) shall reach
from the third number to the fourth.

Example. *There is a Bullet whose*
Diameter is 4 *Inches, weighing* 9 *l.*
What shall another bullet of the same
metall weigh, whose Diameter shall be
8 *inches.*

Extend the Compasses from 4 to
8 (the two Diameters) the same
extent (being tripled) will reach
from 9 to 72, which is the weight of
a bullet whose Diameter is 8 in-
ches.

II. *Of the proportion of SOLIDS*
to LINES.

In this Case, *Extend the Compasses*
unto the third part of the distance be-
tween the two numbers of like denomi-
nation, that same extent shall reach
from the third to the fourth number re-
quired.

Example. *The weight of a Cube*
being 72 *pound, the Side whereof was*

8.

8 *inches ; and the weight of another*
Cube of the same matter weighing 9
pound, what must the side be ?

Upon your line divide the distance
between 9 and 72 into three equal
parts, then set one foot of that distance
in 8, and the other foot shall rest in 4,
the length of the side of the Cube re-
quired.

CHAP. VIII.

The Extraction *of the*
S Q U A R E-R O O T,
By the Line.

TO Extract the Square-Root, is to
find a mean proportional Number
between 1, and the number given, and
therefore is to be found by dividing
the space between them into two equal
parts.

C 4. Example,

Example. *Let it le required to finde the Square-Root of* 36.

Extend the Compasses from 1 to 36, the middle way upon the Line between these two numbers is 6, which is the Square-Root of 36. In like manner may you finde the Square-Root of 81 to be 9, of 144 to be 12, of 256 to be 16; and of other numbers as in this Table.

Root.	Square.	Root.	Square.
1	1	11	121
2	4	12	144
3	9	13	169
4	16	14	196
5	25	15	225
6	36	16	256
7	49	17	289
8	64	18	324
9	81	19	361
10	100	20	400

If

If you suppose the number to have pricks over every second Figure, as is usual in the Arithmetical Operation, then if the last prick towards the left hand fall over the last Figure (which will alwaies be when the number of Figures are odde) then it will be best to place Unity at the 1 in the middle of the line, so that the Root and the Square may both fall forward towards 10 at the end of the Line.

But if the number of Figures be even, it will then be best to place Unity at 10 at the end of the Line ; so the Root and the Square both will fall backwards towards the middle of the Line.

CHAP.

CHAP. IX.

The Extraction *of the*

CUBE-ROOT,

By the Line.

TO Extract the Cube-Root, is to find the first of two mean proportionals between 1 and the number whose Cube-Root you require, and is therefore to be found upon the Line, by dividing the space between them into three equal parts.

Example. *Let it be required to find the Cube-Root of* 216.

Extend the Compasses from 1 to 216, one third part of that distance shall reach from one to 6, which is the Cube-Root of 216. In like manner
may

may you findeth e Cube-Root of 729
to be 9, of 1728 to be 12, of 110592
to be 48, of 493039 to be 79, &c. as
in this Table.

Root.	Cube.	Root.	Cube.
1	1	11	1331
2	8	12	1728
3	27	13	2197
4	64	14	2744
5	125	15	3475
6	216	16	4096
7	343	17	4913
8	512	18	5832
9	729	19	6859
10	1000	20	8000

CHAP.

CHAP. X.

The Use of the Line, applied to

SUPERFICIAL MEASURE,

Such as Board, Glaſs, Wainſcot, Pavement, Hangings, Paintings, &c.
of what kind ſoever.

THe Meaſures by which Board, Glaſs, Timber, Stone, and ſuch like are meaſured, is by the Foot, a Foot containing 12 Inches, and each Inch eight parts called halves, quarters, and half-quarters; but this kind of diviſion not being conſentaneous or agreeable to the diviſions upon your Line of Proportion, where between 1 and 2 is divided (not into 8, but) into 10 parts, the like between 2 and 3 into 10 parts, and ſo between 3 and 4, 4 and 5, &c. Therefore

fore, I hold it requisite both for ease
and exactness, to have every Inch on
your two-foot Rule divided not into
8, but into 10 equal parts, which here-
after (throughout this Book) we will
call Inch-Measure.

Again, Whereas your Foot is di-
vided into 12 equal parts called In-
ches, I would have your Foot divided
into 10 equal parts, and each of those
parts sub-divided into 10 other equal
parts, so will your whole Foot contain
100 equal parts, which will be agree-
able to the divisions of your Line, and
facilitate the work, as by the Exam-
ples in this kind given will be made
to appear; and this we shall hereafter
call Foot-Measure.

But if any person be so wedded to
Inches, halves and quarters, that he
will not be beaten out of his opinion,
but persist therein, and yet is desirous
to have knowledge in the use of this
Line, I say such person may have ad-
ded

ded to the side of his Inches halve
and quarters (by way of faceing, as
term it) a line of Foot-meafure, and
alfo his Inches into 10 as well as 8,
that he may meafure by one, and wor
upon his Line by the other. And thi
indeed will be neceffary to be done
upon the Rules of thofe ingenious Ar-
tificers who need them not, for that
they many times meet with wilfull
perfons that will have them to mea-
fure their way, how diffentaneous
to Reafon foever it be.

In this nature would I have the
Rule divided, and in this manner have
I caufed them to be made both for my
felf and others, a figure whereof I have
inferted towards the end of the Book.

And here note, That what is here
faid concerning dividing the Inch
and Foot into 10 parts, the like is
to be underftood of the Yard, Ell,
Pole

Pole or Perch, or any other mea-
sure whatsoever.

These things being premised, we
will now proceed to Examples.

I. *Examples in Inch-Measure only.*

Example 1. *Let a Board or Planck
be 27 Inches broad, and 263 Inches
long, how many Square Inches is there
in such a Planck?* The Proportion
is,

As 1, is to 27, the breadth in In-
ches ;

So is 263, the length in Inches,.

To 7101, the number of Square In-
ches in the whole Planck.

Extend the Compasses from 1 to
27, the same extent forwards, will
reach from 263, to 7101 the con-
tent.

Or, you may extend the Compasses
from

from 1 to 263, the same will reac
from 27 to 7101, as before.

Example 2. *Let a Pane of Glaſ.
le 53. 4 Inches broad, and* 126. 8 *In-
ches long ; how many Foet is there in
that Pane?* The proportion is,

As 144(becauſe 144 In.hes make
1 Foot)
is to 53. 4, the bredth in Inches;
So is 126. 8 the length in Inches,
to 47. 06 the content in Feet.
Extend the Comp:ſſes from 144
to 53. 4, the ſame will reach from
126. 8, to 47. 06, which is 47 Foot
and $\frac{06}{100}$ parts of a Foot, the content
of the whole Pane.

Example 3. *If a Marble Foot-pace
or Walk be* 20 *Inches bread, how much
in length of that will make a Foot
ſquare?* The proportion is,

As 20, the bredth in Inches,

is

is to 144, the Inches in one Foot;
So is 1 Foot unto the length of one
Foot in Inch-meaſure.

Extend the Compaſſes from 20 to
144, that extent will reach from 1 to
7. 2; ſo that 7 Inches and $\frac{2}{10}$ of that
bredth will make a Foot ſquare.

II. *Examples in Foot-Meaſure only.*

Example 1. *Let a Floor or Stone-
pavement be* 52 *Foot broad, and* 110.
5 *Foot long, how many Foot-ſquare is
in that Floor or Pavement?* The pro-
portion is,
　As 1 Foot.
　　to 52 Foot the bredth;
　So 110. 5 Foot the length,
　　to 5746 the content in ſquare
　　Feet.

Extend the Compaſſes from 1 to
　　　　　　　　　　　52,

52, the same will reach from 110. 5,
to 5746, the content of the Pavement
or floor in square Feet.

Example 2. *There is a Planck of*
Cedar 2 Foot 25 parts broad; how
much in length thereof will make a Foot
square? The Proportion is,

As 2. 25. the breadth,
  is to 1 ;
So is 1, or any number of Feet,
  to the length of a Foot square in
  Foot-measure.
Extend the Compasses from 2. 25
to 1, that extent will reach back from
100, which is one Foot, to 44 parts ;
and so many parts in length of that
Planck will make a Foot. In like man-
ner 88 parts will make 2 Foot, 1 Foot
32 parts will make 3 Foot, &c.
For,

As 2. 25, is to 1 Foot ;

So

$$\text{So is} \begin{cases} 100 \\ 200 \\ 300 \end{cases} \text{to} \begin{cases} 44 \\ 88 \\ 132, \&c. \end{cases}$$

III. *Examples in Inch-Measure and Foot-Measure together.*

Example 1. *Let a Board be 30 Inches broad, and* 15 *Foot and* ¼ *or* 25 *parts long; how many Foot square doth such a Board or Planck contain?* The Analogy is,

As 12 Inches,
to 30 the breadth in Inches;
So 15. 25 the length in Feet,
to 38. 125 the content in Feet.

Extend the Compasses from 12 to 30, the same will reach from 15. 25 to 38. 125; and so many Foot square is contained in such a Planck.

I will conclude this Chapter with this

this usefull and necessary *Problem,*
Namely,

By having the length and bredth of
any Long Square, or Parallelogram, to
finde the length of a side of a Geometri-
cal Square equal thereunto.

Note, By a Long
Square or Paral-
lelogram, *is meant
any Square whose
sides are longer one
than another, as a-
ry long Table, &c.
But a* Geometrical
Square *is that
whose 4 sides are
all of one length.*

This by the Line
is easily effected; for
if you take the half-
distance upon your
Line between the
length & the bredth,
the number upon
which the Compass
point resteth, shall be
the length of the side
of the Geometrical
Square, equal to the Long Square or
Parallelogram.

Example. Let the longer side of a
Parallelogram be 183 Inches, and
the bredth 30 Inches: If you divide
the distance upon your Line between
these

these two numbers into two equal
parts, the Compass point shall rest
upon 74 Inches 10 parts: So that a
Geometrical Square whose side is
74. 10, shall be equal in Area to a
Long Square whose sides are 30 and
183.

CHAP. XI.

OF
YARD-MEASURE

By the Line.

MAny Artificers, as Joyners, Pain-
ters, Plaisterers, Paviers, Up-
holsters, measure and sell their Work,
not by the *Foot*, but by the *Yard*, there-
fore it will be necessary to give Ex-
amples in these kind of Measures also.
And here likewise it is requisite that
your Yard be divided into 100 parts,
                                    and

this usefull and necessary *Problem*, Namely,

By having the length and bredth of any Long square, or Parallelogram, to finde the length of a side of a Geometrical Square equal thereunto.

Note, By a Long Square or Parallelogram, is meant any Square whose sides are longer one than another, as a ry long Table, &c. But a Geometrical Square *is that whose 4 sides are all of one length.*

This by the Line is easily effected; for if you take the half-distance upon your Line between the length & the bredth, the number upon which the Compass point resteth, shall be the length of the side of the Geometrical Square, equal to the Long Square or Parallelogram.

Example. Let the longer side of a Parallelogram be 183 Inches, and the bredth 30 Inches : If you divide the distance upon your Line between

these

these two numbers into two equal parts, the Compass point shall rest upon 74 Inches 10 parts: So that a Geometrical Square whose side is 74. 10, shall be equal in Area to a Long Square whose sides are 30 and 183.

CHAP. XI.

OF
YARD-MEASURE

By the Line.

Many Artificers, as Joyners, Painters, Plaisterers, Paviers, Upholsters, measure and sell their Work, not by the *Foot*, but by the *Yard*, therefore it will be necessary to give Examples in these kind of Measures also. And here likewise it is requisite that your Yard be divided into 100 parts, and

and not into Halves, Quarters, and
Nails; which suppofed, take thefe Ex-
amples following.

Example 1. *A Joyner hath Wainf-*
coted a Gallery containing 130 *Yards*
25 *parts about, and in height* 15 *yards*
50 *parts; how many fquare Yards is in*
that Gallery? The proportion is,

    As 1 yard,
       to 15. 50 yards the height;
    So 130. 25 the compafs in yards,
       to 2018. 87 the content in yards
    Extend the Compaffes from 1 to 15.
50 the breadth, the fame extent will
reach from 130. 25 the length, to
2018.87; and fo many Square Yards
of Wainfcoting is in that Gallery.

Example 2. *A Painter hath paint-*
ed Landskip, or other Work, over the
Wainfcot of a Room, which is 1 *Yard*
75 *parts of a Yard deep; how much*
                                    in

in length thereof will make a Yard Square ?

As the breadth 1.75,
   is to 1 yard or 100 parts ;
So is 1, or any other numb. of yards,
   to the length of a yard square.

Extend the Compasses from 1 to 1. 75, the same extent will reach from 100 (or one yard) to 75. 14 ; and so much in length of that painting will make a yard square.

Example 3. *A Plaisterer hath laid and beautified a Cieling containing* 13 *yards broad, and* 63 *yards* 30 *parts long ; how many square yards is there in that Cieling ?*

As 1 yard,
   to the breadth 13 yards ;
So the length 63. 30,
   to the content.

Extend the Compasses from 1 to
                 13,

13, the same extent will reach from
63. 30, to 823 almost; and so many
square yards are there in such a Ciel-
ing.

> Note, It may so fall out sometimes,
> that it will be required to mea-
> sure some piece of Work, and to
> give the quantity of the yards
> therein contained, when you
> have not a yard thus divided by
> you, but only your two-foot
> Rule; for the supplying whereof
> I will add this following Pro-
> blem.

PROBLEM.

*The length and bredth of any Su-
perficies being given in Feet, to
finde the content thereof in
Yards.*

Let the bredth of a piece of any
Work, to be paid for by the Yard, be 4
Foot, and the length thereof 12 Foot,

how many square Yards are contained therein ?

The Analogie or Proportion is,

As 9,
    is to 4, the bredth in Feet ;
So is 12, the length,
    to 5 $\frac{35}{100}$ the content in yards.

Extend the Compasses from 9 to 4, the same extent will reach (the same way) from 12 to 5. 35, that is, to 5 yards, and 35 hundred parts of a yard, which is 5 yards, one quarter, and almost half a quarter of a yard.

D   CHAP.

CHAP. XII.

OF

LAND-MEASURE.

By the Line.

THe ufual Meafures for Land are Chains, of which there are divers forts; but the denominations of the quantity of Land is given in Acres and Perches.

The Chains now moft in ufe are principally two;

One containing 1 Perch in length, The other 4 Perches in length, } each of them divided into 100 links.

For the practice of them take thefe Examples.

I. By

I. *By the One Pole Chain.*

Example 1. *There is a plat of ground* 30 *Perches broad, and* 183 *Perches long; how many Perches doth it contain?*

As 1,
　to 30 the bredth ;
So 183 the length,
　to 5490 the content.

Extend the Compasses from 1 to 30, that shall reach from 183 to 5490 the content.

Example 2. *But the length and bredth of the same piece of ground being given as before in Perches; if it were required to finde the content in Acres,* then,

　　As 160,
　　　to 30 the bredth ;
　　　　　D 2　　　　　　So

So 183, the length,
 to 34 Acres $\frac{31}{100}$ parts of an Acre.

Extend the Compasses from 160
to 30, the same shall reach (being ex-
tended the same way) from 183 to
34. 31, that is, 34 Acres, 31 hundred
parts of an Acre, which is something
above a Rod.

II. *By the* Four *Pole Chain.*

Example 1. *A piece of Land con-*
taining 16 *Chains* 25 *Links in bredth,*
and 57 *Chains* 30 *Links in length,*
how many Acres doth it contain? The
Analogie is,
 As 10,
  to 16. 25 the bredth in Chains
   and Links;
 So is 57. 30 the length in Chains
  and Links,
  to 93 Acres $\frac{925}{10000}$ parts of an
 Acre.

Extend

Extend the Compasses from 10 to
16. 25, the same extent will reach
from 57. 30, to 93. 0925.

Example 2. *The Base and Perpen-*
dicular of a Triangle being given in
Chains and Links, to finde the content
in Acres.

This is a right usefull and necessary
Proposition ; for by it all manner of
irregular plats of Land are cast up :
But my intent here is not to teach Sur-
veying, I having treated thereof at
large in my compleat Surveyor, but to
shew the use of the Line of Propor-
tion.

Wherefore, Let the Perpendicular
of the Triangle be 7 Chains 50 Links,
and the Base 45 Chains 75 Links, the
proportion will be,

As 20, (alwaies,)
to 7. 50 the Perpendicular ;
So is 45. 75 the Base,
to 17. 15 the content.

Extend the Compasses from 20 to
D 3   7. 50,

7. 50, that extent shall reach from 45.
75 to 17. 15, which is 17 Acres, and
$\frac{15}{100}$ parts.

Example 3. *Having the length of
any Furlong given, to finde what bredth
it must have to make an Acre.*

Let the length of the Furlong be
12 Chains 50 Links, then to finde
the bredth for one Acre this is the
Analogie.

As 12. 50 the length in Chains, is
   unto 10 ;
So is 1 Acre,
   to 80 Links, which must be the
   bredth of the Furlong.

Wherefore,
Extend the Compasses from 10 to
12. 50, the same will reach from 1 A-
cre to 80 Links the bredth of the
Furlong.

CHAP.

CHAP. XIII.

Of the Mensuration of divers Regular
SUPERFICIAL-FIGURES
by the Line.

HAving sufficiently shewn the manner of measuring of such Superficial Figures as are measured by length and bredth, I will now shew you how (by the Line) to measure some other Regular Figures, as the Circle, &c.

I. *Of the* Circle.

Example 1. *The length of the diameter of any Circle being given, to finde the Circumference thereof.*

The proportion between the dia-

meter

meter and the circumference of any Circle is as 7 to 22 ; or, in exacter terms, as 1.000 to 3.140.

Wherefore,

If the diameter of a Circle given be 12 Inches, the circumference thereof may be found by this following Analogie.

As 1.000,
   is to 3. 140 ;
So is 12 the diameter
   to 37. 68 the Circumference.

Wherefore extend the Compasses from 1.000, to 3.140, the same extent shall reach from 12, to 37 Inches 68 parts, which is the Circumference.

Example 2. *The circumference of any Circle being given, to finde the length of the diameter.*

This is the converse of the former Example, and the Analogie is the converse also.

Let

Let the circumference of a Circle be 37 Inches 68 parts, what is the length of the diameter?

As 3. 140,

to 1. 000;

So is 37 Inches 68 parts the circumference,

to 12 Inches the diameter.

Extend the Compasses from 3.140, to 1. 000, the same extent will reach from 37. 68, to 12, the diameter required.

Example 3. *Having the diameter of a Circle, to finde the length of the side of a Square, which shall be equal in content to the same Circle.*

If the diameter of a Circle be 12 Inches, the proportion is,

As 1. 0000.

is to 12 Inches the diameter,

So is 8862,

to 10. 63 the side of the Square.

D 5   Extend

Extend the Compasses from 10000 to 12, the same extent will reach from 8862, to 10 Inches 63 hundred parts, the side of a Square equal in Area to the Circle whose diameter is 12 Inches.

Example 4. *Having the Circumference of a Circle given, to finde the side of a Square equal to that Circle.*

Let the circumference of the given Circle be 37 Inches 68 parts ; The proportion is,

As 10000,

to 37. 68 the circumference ;

So is 2832,

to 10. 63 the side of the Square.

Extend the Compasses from 10000 to 37. 68, the same will reach from 2832, to 10 Inches 63 parts, the side of the Square required.

Example 5. *The diameter of a*
Circle

Circle being given, to finde the superficial content thereof.

Let the diameter of a Circle be 15 Inches.

Extend the Compasses from 1 to 15 the diameter, then apply one foot of that distance (alwaies) to 7854 ; then turn that distance twice from this number the same way, and the Compass point will fall upon 176 Inches 74 parts, which is the Area of that Circle whose diameter is 15 Inches.

Example 6. *The circumference of a Circle being given, to finde the Area thereof.*

Let the circumference of a Circle given be 47 Inches 13 parts.

Extend the Compasses from 1 to 47. 13 the Circumference ; this distance being applyed (alwaies) to this number 7958, and from thence twice repeated, the point of the Compasses, at the second remove, will fall upon

176

176 Inches 74 parts, equal to the Area of the Circle as before.

> *Note.* Here note, That your Compasses being opened from 1 to 47. 13 the Circumference, when you c me to set one foot upon 795 8; the other will reach at your first turning over to 37. 8 ; and when you turn them over again, it will fall out of the line ; wherefore you must set one foot in 37. 8 in the lower part of the Line, and then the other will fall upon 176. 74. And thus you must do in other cases, when ever your Compass point goes beyond your Line.

CHAP.

CHAP. XIV.

II. *Of the* Triangle.

A Triangle is a Figure confifting of three fides and three angles, the longeft fide whereof we call the bafe ; and a line drawn from the Angle oppofite to the bafe, we call, the perpendicular.

To meafure Triangles there are feveral waies ; I will only fhew you one or two to be done by the Line.

Example 1. *There is a Triangle whofe bafe is* 14 *foot, and his perpendicular* 6 *foot, I would know how many fquare Feet is contained in this Triangle.* The proportion is,

As

As 2,
  is to 6 the perpendicular ;
So is 14 the base,
  to 42 the Area.

Or,

As 1,
  is to 3, half the base ;
So is 14,
  to 42 the Area.

Or,

As 2,
  is to 6 the perpendicular.
So is 7 half the base,
  to 42 the Area.

Or,

As 1,
  is to 6 the perpendicular ;
So is 14 the base,
  to 84 the double Area.

All these waies produce the same
effect, but the first is the best :

Wherefore,

Wherefore,

The bafe of your Triangle being
14, and the perpendicular 6; Extend
the Compaffes from 2 to 6, the fame
extent will reach from 14, to 42 the
Area.

III. *Of the* Trapezia.

A *Trapezia* is any right lined figure
confifting of four unequal fides and
as many angles : For the meafuring
of it, you muft fiift reduce it into
two Triangles, by drawing a line or
diameter from one oppofite angle to
another the longeft way, then from
the two angles oppofite to this line,
let fall two perpendiculars ; fo is the
Trapezia divided into two Triangles.
The manner how to meafure it is
this.

Example. *There is a* Trapezia
whofe diameter is 12. 34, *and one per-*
                                    pen-

pendicular is 4. 20, the other 5. 07; I would know the Content or Area thereof.

The two perpendiculars added together make 9. 27. Then the analogie is,

 As 2,

  is to 9. 27, the sum of the perpendiculars;

 So is 12. 34, the base,

  to 57. 19, the Area.

There are as many waies to measure Trapezias, as in the last Example I gave you for Triangles; but this is the best.

And here note, That if you are to measure any irregular piece, of what nature soever, whether Land, Board, Glass, Pavement or the like, your best and exactest way is to reduce them to Trapezias, and measure them as before is taught.

     IIII. Of

IIII. *Of Regular Figures of 5, 6, 8, 10 or 20 equal sides.*

These Figures by Geometricians are called *Regular Polygons*, and the way to measure them is by adding all the sides together. Then measure the length from the centre of the figure to the middle of one of the sides; by the help of these two you may finde the Area of the Figure.

Example. *Let there be a Regular Polygon of* 11 *equal sides, each side being* 7 *Inches; and let the length of the line from the centre to the middle of one of those sides be* 12 *Inches.*

Add all the sides together they make 77; then,

As 2,

is to 77 the sum of the sides;

So is 12, the length of the line from the middle of the figure to

462, the content of the figure.

CHAP.

CHAP. XV.

The Use of the Line applyed to

SOLID-MEASURE,

Such as Timber, Stone, *&c.*

Timber and Stone are usually mea-
sured by the same Rule or Mea-
sure, as Board and Glass are, namely,
by Feet and Inches : Therefore such
a Rule as was mentioned in the begin-
ning of the Tenth Chapter is fit for
this business also.

Before we come to shew the way
of measuring of Stone or Timber, it
will be necessary to premise thus
much, That the base or end of every
piece of Timber or Stone is (or must
be supposed) either exactly square,

that

that is, every side alike, or else one of
the sides longer than the other: where-
fore the first thing to be done is to
finde the Area, or superficial content
of the base or end of any piece of
Timber or Stone to be measured, which
may be done several waies, either in
Inch-measure, as by the first Example
of the first part of the tenth Chapter ;
or in Foot-measure, by the first Ex-
ample in the second part of the same
Chapter; or both in Foot-measure and
Inch-measure, as in the first Example
of the third part of the same tenth
Chapter ; and therefore need not be
here repeated again : Wherefore we
will proceed to our intended purpose
of Measuring, first, by Inch-measure
only ; secondly, by Foot-measure on-
ly; and thirdly, by both together, as
we did before in the measuring of
Board, &c.

I. *In*

I. *In Inch-Measure only.*

Example 1. *There is a piece of Timber 30 Inches broad, 21 Inches 6 parts deep, and 183 Inches long; how many square Inches are there in this solid piece of Timber?* The proportion is,

1. As 1,
   unto 30 Inches the bredth;
So is 21. 6 Inches the depth,
   to 648 Inches, the content of
   the base of the piece.

2. As 1,
   unto 648, the content of the
   base;
So is 183 Inches the length of the
   piece,
   to 118584, the solid content in
   Inches.

Wherefore, Extend the Compasses from 1 to 30 the bredth; the
same

same will reach from 21. 6 the depth,
to 648 the content of the base.————
Again, extend the Compasses from 1
to 648 the content of the base ; that
extent will reach from 183 the length
to 11 85 84 Inches the solid content.
But so many places of Figures can-
not well be estimated upon your Line,
except it be very large ; but by fol-
lowing Examples you shall have your
desire accomplished exactly and
easily.

Example 2. *To finde the content
of the same piece of Timber in Foot-
measure, the dimensions being given
in Inches and parts.* The proportion
is,

1.   As 1,
       to 30 the bredth ;
      So 21. 6 the depth,
        to 648 the content of the base,
          as before.

2. As

2.   As 1728, the number of solid
            Inches in a Foot of Timber,
            is to 648, the content of the
            base ;
        So is 183 the length in Inches,
            to 68 Foot, and $\frac{612}{1728}$ parts of a
            Foot, as before.

Wherefore, as before, extend the
Compasses from 1 to 30 the bredth ;
the same will reach from 21. 6 the
depth, to 648 the content of the base,
as before.——— Again , extend the
Compasses from 1728 to 648 the
base, the same extent will reach the
same way, from 183 the length, to 68.
62 the content of the piece of Tim-
ber in Feet and parts, that is 68 Foot,
and above half a Foot.

Example 3. *Let a squared Stone
or piece of Timber be 30 Inches broad,
and 21 Inches six parts deep ; how
much in length shall make a Foot*
                                    square

square of that piece of Timber or Stone?

You may finde the content of the bafe, as in the laft Example, to be 648 Inches; the the proportion is,

As 648, the content of the bafe,
    is to 1728, the Inches in a Foot;
    So is 1,
        to 2 inches 67 parts, the length
of a Foot folid.

Therefore, extend the Compaſſes from 648 the bafe, to 1728, the fame will reach from 1 to 2. 67: So that 2 inches parts will make a Foot folid of that piece of Timber or Stone.

This may be done another way by this Analogie or Proportion.

1. As 12,
        to 30 the bredth in inches;
        So 21.6, the depth in inches,
            to a fourth number (which here
                will be about 54.)

2. As

2.   As this fourth number 54,
      is to 144;
    So is 1,
      to 2. 67, the length of a Foot
      solid.

Wherefore, extend the Compasses
from 12 to 30 the bredth, that extent
will reach from 21. 6 the depth, to a
certain place upon the Line (about
54,) where keep the one point of the
Compass fast, and open the other to
144, then will this extent of the Com-
passes reach from 1 to 2 inches 67
parts, the length of a Foot solid, as
before.

II. *In Foot-Measure only.*

Example 1. *Let a Stone or a piece
of Timber be 2 Foot 50 parts broad,
1 Foot 80 parts deep, and 15 Foot 25
parts long, how many solid or cubical
Feet doth such a piece contain?*

The

The proportion is,

1. As 1,
    is to 2. 50 Foot the bredth ;
    So is 1. 80 Foot the depth,
    to 4. 50 Foot, the base in such
    measure.

2. As 1,
    unto 4. 50 the base ;
    So 15. 25 the length,
    to 68.62, the content in Feet.

Extend the Compasses from 1 to
2. 50 the bredth ; the same will reach
from 1. 80 the depth, to 4. 50 the
base.——— Again, extend the Com-
passes from 1 to 4. 50 the base; that
extent will reach from 15. 25 the
length, to 68. 62, the content in
Feet.

Example 2. *In the forementioned
piece of squared Stone or Timber, be-
ing 2 Foot 50 parts broad, and 1 Foot*
E   *80 parts*

80 *parts deep, Let it be required to*
finde how much thereof in length will
make a Foot. The proportion is,

1. As 1,
    is to 2. 50, the bredth ;
 So is 1. 80, the depth,
    to 4. 50, the content of the base
    in Foot-measure.

2. As 4. 50, the base,
    is to 1 ;
 So is 1 Foot,
    to 222 parts, the length of a Foot
    solid.

Wherefore, extend the Compas-
ses from 1 to 2. 50 the bredth; the
same extent will reach from 1. 80 the
depth, to 4. 50, the content of the
base.——Again, extend the Com-
passes from 4. 50 the base, to 1; the
same will reach from 10 to 222 parts,
the length of a cubical or solid Foot
of that Stone or piece of Timber.

III. *In*

III. In FOOT-MEASURE and INCH-MEASURE together.

Example. *Let a squared Stone or piece of Timber be* 30 *Inches broad,* 21. 6 *Inches deep, and* 15 *Foot* 25 *parts long, how many cubical or solid Foot of Stone or Timber is there in that piece?*

The proportion is,

1. As 1,
    is to 30 inches, the bredth;
    So is 21.6 inches, the depth,
      to 640, the content of the base
      in inches.

2. As 144, the inches in a Foot superficial,
    is to 648, the content of the base
      in inches;
    So is 15. 25, the length of the
      piece in Foot-measure,
      to 68 Foot 62 parts.

E 2   Where-

Wherefore, extend the Compasses from 1, to 30 the bredth, the same will reach from 21. 6 the depth, to 648, the content of the base. —— Again, extend the Compasses from 144, to 648 the content of the base, the same extent will reach from 15 25 the length of the piece, to 68 62 the solid content of the Stone or Timber in Feet and 100 parts of a Foot.

By having the same things given in the same piece of Stone or Timber (or in any other) the work may be varied several waies: The Analogies or Proportions I will only give you, leaving the practise thereof to your self.

Bredth of the piece 30 inches.
Depth of the piece 21. 6 inches.
Length of the piece 15. 25 foot.

The

The Proportions.

1. As 144,
   to 30, the bredth;
   So 21. 6, the depth,
   to a fourth number.

From which fourth number, if you extend your Compasses to 1, and place one foot in 15. 25, the length of the piece, the other foot shall fall upon 68. 62, the content of the Stone.

Or,

2. As 12,
   unto 30, the bredth;
   So 21. 6, the depth,
   to some fourth number.

From this fourth number, extend the Compasses to 12, that distance will reach from 15. 25, the length of the piece, to 68. 62, the content of the piece.

E 3   CHAP.

CHAP. XVI.

How to measure Stone *or* Timber
by the Line, by having the
Square of the Base, and the
length of the Piece given,
both in Foot *and* Inch-mea-
sure.

HOw to finde the length of a
Side of a Geometrical Square,
that shall be equal to any Parallelo-
gram or Long Square, is taught at the
later end of the Tenth Chapter of
this Book, by which Rule it may at
any time be found : That being done
there, I shall only here begin with
Examples.

Example

Example 1. *There is a Squared piece of Timber whose length is* 183 *Inches, and the side of the Square equal to the base or end thereof is* 25 *Inches* 45 *parts; how many Foot doth that piece contain?*

1.   As 41, 57,

　　　to 25. 45, the side of the
　　　　Square;

　　So is 183, the length in Inches,
　　　to a fourth number.

2.   And that fourth number,

　　　to 68. 62, the content in Feet.

Extend the Compasses from 41.57, to 25. 45, the side of the Square; the same will reach from 183, the length, to some other part of the Line; from whence if you again extend the same distance, the point will rest upon 68 Foot $\frac{62}{100}$ parts of a Foot; and so many Foot is in the piece.

E 4   Example.

Example 2. Let the side of a Square,
equal to the Base of a piece of Stone,
or Timber, be 2 Foot 12 parts, and
the length of the same piece 15 Foot
25 parts, how many solid Foot is there
in that piece?

1. As 1.

to 2 Foot 12 parts the side of
the Square;
So 15 Foot 25 parts, the length,
to a fourth number.

2. And that fourth number,
to 68.62, the content in Feet.

Extend the Compasses from 1 to 2.
12, the side of the Square; that will
reach from 15. 25, the length, to some
other number on the Line, upon which
number the Compasses being turned
about, the movable point will fall up-
on 68. 62, the content, as before.

Example

Example 3. *The side of a Square,
equal to the Base of a Stone, being
25 Inches 45 parts, and the length of
that Stone 15 Foot 25 parts, how ma-
ny Foot doth it contain?*

1.　As 12,
　　　to 25.45, the Square in Inches;
　　So is 15. 25 Foot, the length,
　　　to a fourth number.

2.　And that fourth number,
　　　to 68.62, the content.

Extend the Compasses from 12 to
25. 45 the side of the Square; the
same will reach from 15. 25, to some
other point upon the Line, from
whence the movable point of the
Compasses will fall upon 68 Foot 62
parts, the content of the Stone.

Example 4. *There is a piece of Timber whose side of the Square of the Base is* 25 *Inches* 45 *parts; how much in length of that piece will make a Foot solid?*

1. As 25.45, the side of the Square,
   is to 41.57;
   So is 1 Foot,
   to a fourth number.

2. And that fourth number,
   to 6 Inches 67 parts.

Wherefore, extend the Compasses from 25. 45 the side, to 41. 57; the same will reach from 1 to some other point, from whence the Compasses will reach to 6. 67, the length of a Foot solid of that piece of Timber.

Example 5. *The length of the side of a Square, equal to the Base of a*
                                    piece

piece of Timber being 2 Foot 12 parts, to finde how much in length of that piece will make a Foot solid in Foot-measure.

As 2.120, the side of the Square,
    is to 1.000.;
So is 1.000,
    to a fourth number :
And that fourth number,
    to 0. 471 parts of a Foot, to
    make a Foot square.

Extend the Compasses from 2.120 the side of the Square, to 1.000; the same extent will reach from 1.000, downwards, to some other point upon the Line, and from thence downwards, to 222 parts of a Foot ; and so much in length will make a Foot solid.

CHAP.

CHAP. XVII.

Concerning Timber *that is bigger at one end than at the other, either Round or Square; and how to measure it.*

I. For *SQUARED TIMBER*.

IN large Timber-trees, when they are squared, there is a great disproportion between the Squares of both ends; wherefore some do use to take the Square of the middle of the piece for the mean or true Square; but this is not exact, though much used; but the best way is this: Finde by the Problem at the end of the tenth Chapter of this Book, the length of the side of a Square equal to both the ends

ends of the piece, add these two
sides together, and take the half there-
of for the true Square; and with that
Square you may by the Rules of the
last Chapter measure it as if it were
perfectly Square.

II. *For ROUND TIMBER.*

The ordinary way used for the
measuring of Round Timber, is to
girt it about the middle with a Line,
and to take one fourth part thereof for
the side of a Square equal thereto:
but this is false, though most men use
it, Custome having made it bear the
face of Truth; for it is more in
measure than in reality it should
be.

But the exact way of measuring of
Round Timber (especially if it be
growing) is this: About the middle
thereof,

thereof, in some smooth place, gi
the same about with a string:

Then have you this proportion.

As 1000,

   is to the number of Inches about
So is 2821,

   to the length of the side of a
   Square equal thereunto.

So if a Tree, being girt about, as
abovesaid, should contain in circum-
ference 47 Inches 13 parts :

If you extend the Compasses from
1000 to 47 Inches 13 parts, the same
extent will reach from 2821, to 13
Inches 29 parts, which is equal to the
side of a Square equal to that Tree,
which being obtained, the Tree may
be measured divers waies, according
to the Examples in the last Chapter.

CHAP.

CHAP. XVIII.

Concerning the measuring of Regular Solids, *as* Cylinders, Globes, Cones, *and such like.*

I. Of *the* CYLINDER.

A *Cylinder* is a round Figure, of equal circumference in all parts thereof, as a standing Pillar, a Rowling-stone for Garden-walks, &c. To measure such a Figure there are several waies, both by having the circumference given when it is standing, or by having the diameter at the end thereof when it is lying, or by having the side of a Square equal to the base thereof.

I. *By*

I. *By having the* Diameter *given.*

Example 1. *The Diameter being*
15 Inches, how much in length makes
Foot?

As 15 the diameter,
   to 46. 90 ;
So is 1,
   to a fourth.
And that fourth,
   to 9. 78, the length of a Foot.

Extend the Compasses from 15 the
diameter, to 46. 90; that extent will
reach from 1, to another point upon
the Line, and from thence to 9 Inches
78 parts, the length of a Foot solid.

Example 2. *The diameter being 1*
Foot 25 parts, how much in length
makes a foot in Foot-measure?

As

As 1.25, the diameter in Feet,
   unto 1.128;
So 1,
   to a fourth number,
And that,
   to 8.14, the length of a Foot so-
   lid in Foot-measure.

Extend the Compasses from 1.25
the diameter, to 1.128; the same
will reach from 1, to some other num-
ber, and from thence to 1 Foot 128
parts of a Foot.

Example 3. *Having the diameter*
15 *Inches, and the length* 105 *Inches,*
how many solid Inches doth the Cylin-
der contain ?
   As 1.128,
      to 15 Inches the diameter ;
So is 105 Inches, the length,
   to a fourth number,
   And that,
   to 18555.34 Inches, the content.
                                    Extend

Extend the Compasses from 1.128, 15
to 15 the length; the same extent will bo
reach from 105 the length, to some
other number, and from thence to
18555. 34 Inches, the content of the
Cylinder in Inches.

Example 4. *Having the diameter*
1 Foot 25 parts, and the length 8 Foot
75 parts, to finde the content in Feet.
  As 1. 128,
    to 1. 25, the diameter;
  So 8. 75, the length,
    to a fourth,
 -And that fourth,
    to 10. 74 Foot, the content.

Extend the Compasses from 1.128,
to 1. 25 the diameter; that extent
will reach from 8. 75 the length, to
some other number, and from that to
10 Foot 74 parts, the content.

Example 5. *Having the diameter*
15

15 *Inches, and the length* 105 *Inches,*
how many Foot doth it contain?
  As 46. 90,
    to 15 Inches, the diameter;
  So is 105 Inches, the length,
    to a fourth,
  And that fourth,
    to 10 Foot 74 parts, the content.

Extend the Compasses from 46.90, to 15 the diameter; that extent will reach from 105 the length, to another number, and from that to 10 Foot 74 parts, the content.

Example 6. *The diameter being* 15 *Inches, and the length* 8 *Foot* 75 *parts, how many Foot doth it contain?*
  As 13. 54.
    to 15 Inches, the diameter;
  So 8. 75 Foot the length,
    to a fourth,
  And that fourth,
    to 10. 74, the length in Feet.
               Extend

Extend the Compasses from 3. 54
to 15 the length, that extent will reach
from 8. 75 the length, to another
number, and from thence to 10. 7~
Foot, the content in Feet.

II. *By having the* Circumference
given.

Example 1. *The Circumference of*
a Cylinder is 47 Inches 13 parts, how
much thereof in length shall make a
Foot solid?
    As 47. 13 Inches, the circum-
        ference,
    to 147. 36 ;
    So 1,
    to a fourth number,
    And that,
    to 9. 7⁸ Inches, the length of a
        Foot.

Extend the Compasses from 47.13,
the circumference, to 147. 36; that
extent

extent will reach from 1, to a fourth number, and from thence to 9 Inches 78 parts, the length of a Foot solid.

Example 2. *Having the circum-ference of a Cylinder 3 Foot 927 parts, to finde the length of a Foot solid thereof in Foot-measure.*

As 3. 927 Foot,
   to 3. 545 ;
So 1,
   to a fourth number,
And that,
   to 815 parts of a Foot, the length.

Extend the Compasses from 3.927, the circumference, to 3. 545 ; that extent will reach from 1, to some o-ther number, and from thence to 815 parts of a Foot, for the length of a solid Foot of that Cylinder.

Example 3. *The circumference of a Cylinder being 47 Inches 13 parts,*
                      and

and the length thereof 105 Inches, how
many Inches is there in such a Cylin-
der?

As 3. 545,
  to 47. 13, the circumference;
So 105 Inches, the length,
  to a fourth number,
And that,
  to 18555, the content in Inches.

Extend the Compasses from 3.545,
to 47. 13 the circumference; that ex-
tent will reach from 105 the length,
to another number, and from thence
to 18555, the number of solid Inches
in the Cylinder.

Example 4. *The circumference be-*
ing 47 Inches 13 parts, and the length
105 Inches (as before;) how many
solid Foot in that Cylinder?

As 147. 36,
  to 47. 13 Inches, the circum-
    ference.   So

So 105 Inches, the length,
  to a fourth number,
And that,
  to 10 Foot 74 parts, the content.

Extend the Compasses from 147.
36, to 47. 13 the circumference, that
extent will reach from 105 the length,
to another number, and from that to
10 Foot 74 parts of a Foot, the solid
content.

Example 5. *Let the length of the
Cylinder be* 8 *Foot* 75 *parts, and the
circumference* 3 *Foot* 927 *parts ; how
many Foot doth it contain ?*

  As 3. 545,
    to 3. 927 Foot, the circum-
      ference ;
  So 8. 75 Foot, the length,
    to a fourth number,
  And that,
    to 10 Foot 74 parts, the content.
                                    Extend

Extend the Compasses from 3.545 to 3.927; the same extent will reach III. from 8.75 the length, to 10.74, the content in feet.

Example. 6. *Let the circumference given be 47 Inches 13 parts, and the length 8 Foot 75 parts; how many solid Foot doth the Cylinder contain?*

As 42.54,
　　to 47.13 Inches the circumference;
So is 8.75 Foot, the length,
　　to a fourth,
And that fourth,
　　to 10.74 Foot, the content.

Extend the Compasses from 42.54, to 47.13 the circumference; that extent will reach from 8.75 the length, to another number, and from thence to 10 Foot 74 parts, the content of the Cylinder in solid Feet.

III. *By*

III. *By having the Side of a* Square, *equal to the Base or End of a* Cylinder.

Example. *Let the Side of a Square, equal to the Base or End of the Cylinder, be 13 Inches 29 parts, and the length thereof 105 Inches; how many square Feet are contained in that Cylinder?*

As 41. 57,
   to 13. 29 Inches, the side of the
     Square;
So is 105, the length in Inches,
   to a fourth number,
And that,
   to 10 Foot 47 parts, the content
     of the Cylinder in Feet and
     parts.
Extend the Compasses from 41.57,
to 13. 29 Inches, the side of a Square
equal to the base of the Cylinder;
        F   that

that extent will reach from 105 Inch-
es, the length, to another number th
and from thence to 10 Foot 47 parts
the content of the Cylinder in Feet. fo

II. *Of the* CONE.

A *Cone* is a round Figure, having
for the base thereof a Circle, the side
whereof riseth from the circumference
of the Circle round about the same
equally, till it meet in a point just o-
ver the centre of the Circle, and is
in the form of a Spire-Steeple : And
it is thus measured.

Example 1. *Let there be a Cone*
the diameter of whose Base is 10 *Inch-*
es, and whose height is 12 *Inches; I*
would know how many solid or cubical
Inches are contained therein.

The diameter being 10, the con-
tent of the Circle or Base will be
found to be 78 Inches 54 parts; as
by

by the fifth Example in Chap. 13. of this Book.

The Area of the Base being thus found, the proportion is,

As 3,
  to 78. 54 Inches, the content of
    the base;
So is 14 Inches, the height,
  to 314 Inches 16 parts of an
    Inch, for the content of the
    Cone in Inches.

Extend the Compasses from 3, to 78. 54 the base; that extent will reach from 12 the height, to 314 Inches 16 parts, the content of the Cone in solid Inches.

Example 2. *Let the diameter of the Base be 12 Inches, as before, and the length of the side be 13 Inches; how many solid Inches is there in this Cone?*

F 2   1. Ex-

1. Extend the Compasses from 1, to 5 Inches, half the diameter of the Base, that extent will reach from 5 to 25.

2. Extend the Compasses from 1, to 13 the length of the side; that extent will reach from 13, to 169.

3. From this 169, take the 25 before found, and there remains 144.

4. Upon your Line take half the distance between 1 and 144, and you shall finde it to be 12, which 12 is the height of the Cone: So the height being had, you may finde the content, as in the last Example.

XI. *OF SPHERICAL BODIES.*

A Spherical Body, is such a Body, whose Superficies in all the parts of it are equally distant from the

centre

centre of the body; as Globes, Bullets, &c.

Example 1. *The Circumference of a Globe or Bullet being* 28 *Inches* 28 *parts, to finde the length of the diameter.*

As 22,
   to 7;
So is 28. 28, the circumference,
   to 9 Inches, the diameter.

Extend the Compasses from 22, to 7; the same extent will reach from 28.28 the circumference, to 9 Inches, the length of the diameter of that Bullet.

Example 2. *The diameter of a Spherical Body being given is* 9 *Inches, and its circumference is* 28 *Inches* 28 *parts, how many square Inches is there in the superficies of that Spherical Body?*

F 3   As

As 1,

is to 9 Inches, the diameter;

So is 28. 28 Inches, the circumference,

to 254. 5 Inches, the superficial content.

Extend the Compasses from 1, to 9 the diameter; the same extent will reach from 28. 28, the circumference, to 254 Inches 5 parts, the superficial Inches in this Spherical Body.

Example 3. *The diameter of a Spherical Body being 9 Inches; how many solid Inches are therein contained?*

1. As 1,

is to 9. the diameter;

So is 9,

to a fourth number,

And that fourth number,

to 729, the cube of the diameter.

2. As

2. As 9, the diameter,
    to 729, its cube ;
  So is 11,
    to 891 Inches, the solid con-
        tent of the Spherical Body.

Extend the Compasses from 1 to
9, that extent will reach to 81, and
from 81, to 729, the cube of the dia-
meter.——— Then, extend the Com-
passes from 9, the diameter, to 729
its cube ; that extent will reach from
11, to 891 Inches, the solid content
of the Spherical Body.

I might here add the manner how
to measure other kind of Bodies, both
Regular and Irregular ; as *Ellipses,*
Parabolas, &c. Also of *Prismes,*
Scalene, Cones, Spheroiades, &c. But
these being out of the reach of ordi-
nary Artificers, for whose sakes this
Treatise was chiefly composed, I
            F. 4   shall

shall here conclude this Treatise of
the Use of the Line of Proportion,
with a short Supplement of Gauging
of Vessels.

CHAP. XIX.

Concerning the

Gauging of Vessels

By the Line.

BEfore you can measure your Ves-
sel, to finde the content there-
of in Gallons or parts, you must finde
the content thereof in solid Inches;
and to effect this, you must finde the
content of two third parts of a Circle,
agreeable to the diameter at the
Bung; and one third part of another

<div align="right">Circle,</div>

Circle, agreeable to that of the dia-
meter at the Head ; thefe two added
together, and multiplyed by the length
of the Veffel, that product will be
the content of that Veffel in Inches.

Example.
Let there be a
Veffel whofe

{ diameter at Head, 18
{ diameter at Bung, 32
{ length is   40

And let the content thereof, firft in
Inches, and then in Gallons, be re-
quired.

I. *For the two third parts of the*
    Circle *at the* Bung.

As 1,
   to this univerfal number [5236.]
So 1024. the fquare of the diame-
   ter at the Bung 32.
to 536. 166 Inches, which is two
     third parts of the content of
     the Circle at the Bung.

F 5   Where-

Wherefore, extend the Compasses from 1, to 5236; the same extent will reach from 1024, (the square of 32 the diameter at the Bung) to 536. 166 inches, the content of two third parts of the circle at the Bung.

II. *For one third part of the* Circle *at the Head.*

As 1,
to this general number [2618;]
So is 324, the square of the diameter at head 18,
to 84. 823 Inches, which is one third part of the content of the circle at the head.

Wherefore, extend the Compasses from 1, to 2618; the same extent will reach from 324 (the square of 18, the diameter at the Head) to 84. 823 Inches, the content of one third part of the diameter at the head.

III. *For*

III. *For the number of* Square Inches *in the* Vessel.

Add these two numbers- 536. 166
and 84. 823

They make- 620. 989
40

Which multiplyed by 40, the length of the Vessel, produceth- } 24839.560

And so many Square Inches are contained in such a Vessel, whose diameter at the Head is 18 Inches, at the Bung 32 Inches, and is 40 Inches long.

IV. *For*

IV. *For the* Content *in* Wine *or* Ale Gallons.

Divide this num- ⟩ 231 for Wine,
ber 24839.56, by --⟩ 282 for Ale,
and the Quotients fhall tell you the
number of Gallons and parts of a
Gallon.

  Wine.   *gall. parts.*
  231)24839.56(107.52.
     . . . . .
      231
     1739

     1617
     1225

     1155
      706

      693
       13

Ale

Ale.   gall. parts.
282) 24839. 56 (88. 08
        .. ..
            _____

            2256
            2279
            _____

            2256
            2356
            _____

            2256
            100

By this work you⎫ 107 Gallons 53
may perceive that ⎬ parts of Wine
this Vessel con- ⎪ measure.
taineth   ⎬ 88 Gallons 08
                  ⎪ parts of Ale
                  ⎭ measure.

How to multiply and divide by the
   Line, is taught in the Second
   and Third Chapters of this
   Book, and therefore were need-
   less here to repeat it again : But
                                    I

I chose rather to do it Arithmetically, for the better illustration, and for the satisfaction of such as have a delight in Numbers.

HOW.

How to Meaſure.

Board, Glaſs, Timber, Stone, &c.

By a Line of Equal Parts, drawn from the Centre of a

Two-Foot Joynt-Rule.

ALL Proportions that may be wrought upon a ſtraight Ruler by the Line of Proportion or Numbers, the ſame may be wrought by a Line of equal Parts, drawn from the Centre of an opening Joynt.

And whereas this Line of Equal Parts is numbred from the Centre of
the

the Rule towards the end thereof, 1,2,3,4,&c. to 10; that these Figure (as in the other Line) do sometime signifie themselves only; sometime 1, 2, 3, &c. do signifie 10, 20, 30 &c. sometimes 100, 200, 300, & according to the quality of the Question propounded.

By this Line you may also Multiply, divide, work the Rule of Proportion, and perform divers things which the Line of Numbers performeth, and some others which that will not; but I shall here only shew you how Board, Glass, Timber, Stone, &c. may be thereby measured; which I shall do in these following Propositions. And,

I. For

I. For *SUPERFICIAL MEA-SURE*, *as* Board, Glaſs, &c.

I. *In INCH MEASURE*.

PROP. 1.

A Plank being 27 *Inches broad,
and* 263 *Inches long* ; *how many
Square Inches are contained
therein ?*
As 1,
 īs to 27 :
So is 263,
 to 7101.

Take in your Compaſſes the di-
ſtance from the Centre, to 27 (the
bredth) upon your Line of Equal
parts ; with this diſtance ſet one foot
in 10 at the end of the Line, and o-
pen the Rule till the other foot fall in
10 on the other Leg of the Rule.

The

The Rule thus standing, take with your Compasses the distance between 263 on one Leg of the Rule, to 263 on the other Leg, this distance will reach from the Centre of the Rule to 7101; and so many square Inches are in that piece.

PROP. 2.

If a Board, or Plank, or piece of Pavement, or of Glass, be 20 Inches broad, how much thereof in length shall make a Foot square?

As 20,
  is to 144;
So 1,
  to 7. 2.

Take 144 out of your Line of Equal parts, from the Centre, and setting one foot in 20, open the other Leg till the other Compass point fall in 20 also.   The

The Rule thus ſtanding, take the diſtance between 10 and 10, and that diſtance will reach from the centre of the Rule to 7 Inches $\frac{2}{10}$ parts of an Inch; and ſo much in length will make a Foot Square.

II. *In FOOT-MEASURE.*

PROP. 3.

A Room is 52 Foot broad, and 110. 5 Foot long; how many Square Foot are there in that Room?

As 52,
  is to 1 ;
So is 110. 5,
  to 5746.

Take in your Compaſſes 52 the bredth; with this diſtance open the Ruler in 10, and 10; it ſo reſting, take the diſtance between 110. 5 and

110. 5

110. 5 on either side, that distan
applied to the Centre of the Rul
will reach to 5746; and so ma
Square Foot is in that Room.

PROP. 4.

*A Plank being 2 Foot 25 par
broad; how much in length ther
of shall make a Foot Square?*

As 2. 25, the bredth,
  is to 1 or 10;
So is 10,
   to 44, the length of a Foot.

Take in your Compasses the di-
stance from the Centre of your Rule
to 1; then set one foot in 2. 25,
and open the other Leg till the other
Compass point fall in 2. 25 on the
other side; the Rule thus standing,
take the distance between 10 and 10;
that distance applied from the Centre
              of

the Rule, will reach to 44 parts of
Foot; and so much in length will
make a Foot.

III. *In YARD-MEASURE.*

PROP. 5.

*A Room is hung with Tapestry,
containing 130 Yards 25 parts in
compass, and in depth 5 Yards
20 parts; how many Yards of
Tapestry is in that Room?*

As 1, to 5. 20;
So 130. 25, to 677. 4.

Take 5. 20 in your Compasses, and
that distance put over in 10 and 10;
the Rule thus standing, take the di-
stance between 130. 25 and 130. 25
on each Leg of the Rule, that di-
stance will reach from the Centre of
the Rule, to 677 Yards 4 tenths of a
Yard.

Il. *Fr*

II. *For SOLID MEASURE,*
Timber, Stone, &c. *By t*
Line of Equal parts.

I. *In INCH-MEASURE.*

PROP. 1.

A piece of Timber being 30 Inches
broad, 21 Inches 6 parts deep,
and 183 Inches long; how many
Foot is contained in that piece of
Timber ?

1. As 1,
   is to 30 ;
  So is 21. 6,
   to 648.

Take the distance from the Centre
to 30 ; then set one foot in 10, and
open the Rule till the other Compass
          point

oint fall in 10 on the other Leg of he Rule : Then take the diftance be-ween 21.6 and 21.6, that diftance vill reach from the Centre of the Rule, to 648, the content of the bafe or end of the piece of Timber in Inches : Then,

2. As 1728, the number of Inches
       in a Foot folid,
    is to 648, the content of the
       bafe ;
    So is 183 Inches, the length,
       to 68 Foot 62 parts, the con-
       tent in Feet.

Take in your Compaffes the di-ftance from the Centre to 1728, with this diftance fet one foot in 648,then open the other Leg of the Rule till the other point of the Compaffes fall in 648 on the other Leg ; then take in your Compaffes the diftance from the Centre to 183 ; with this diftance
                                    move

move both points of the Compass
gently along on both the Lines o
either side the Rule, till the Compas
points rest upon one and the same
number on either Leg, which you shall
here finde them to do at 68. 62 parts:
so the piece containeth 68 Foot and
$\frac{62}{100}$ parts of a Foot.

This kinde of work may seem trou-
blesome at first ; but little pra-
ctise will render it easie.

Note. If you take, the first number
of your proportion from the cen-
tre of your Rule, you must take
your third number thence also,
and then will your number sought
be found as this here in this Ex-
ample. But if you take your first
number cross the Rule, then your
third number must be so taken al-
so, and your number sought must
be taken from the centre, as those
before were.

PROP.

PROP. 2.

If a Stone be 30 *Inches broad, and* 21 *Inches* 6 *parts deep; how much in length of that Stone will make a Foot Square ?*

You must first finde the content of the base, as in the first Proposition, and it will be 648 Inches : Then,

As 648, the content of the base,
  is to 1728, the Inches in a solid
    Foot ;
So is 1,
  to 2. 67 parts.

Take 1728 in your Compasses from the Centre ; with that extent open the Rule from 648, to 648 : The Rule so resting, take the distance between 10, and 10 ; that distance applied to the Line from the Centre,

G   shall

shall reach to 2 Inches 67 parts; an ter
so much in length will make a Foote F
solid of that Stone or piece of Tim nt
ber.

II. *In FOOT MEASURE.*

PROP. 3.

If a Stone or piece of Timber be
2 Foot 50 parts broad, 1 Foot
80 parts deep, and 15 Foot 25
parts long; how many solid Feet
doth that piece contain?

1. As 1,
     is to 2. 50, the bredth;
   So is 1. 80, the depth,
     to 4. 50, the content of the
       base in Feet.

Take 2. 50 in your Compasses from
.he Centre; with that extent open
the Rule in 10 and 10, then take the
distance between 1, 80 and 1.80, that
                              extent

s; and tent will reach from the Centre of
Foote Rule, to 4 Foot 50 parts, the con-
Timent of the base.

As 1,
　　to 4. 50, the base;
　　So 15. 25, the length,
　　　　to 68.62, the content in Feet.

Take 4. 50 in your Compasses, and
thereto open the Rule from 10 to 10;
then take the distance between 15. 25
and 15. 25, that distance will reach
from the Centre of the Rule, to 68
Foot 62 parts, the content of the
Stone.

PROP. 4.

The bredth being 2 Foot 50 parts,
the depth 1 Foot 80 parts; how
much in length thereof will make a
solid Foot?

You may finde the quantity or con-
　　　　　　　tent

tent of the base by the first of the last Proposition to be 4 Foot 50 parts. Then,

> As 4, 50, the base,
> is to 1 ;
> So is 10, or one Foot,
> to 222 parts.

Open the Compasses from the Centre to 1 ; then setting one foot in 4. 50, open the other Leg till the Compass point falleth in 4. 50 on the other Leg ; then take the distance between 10 and 10, and that will reach from the Centre to 222 ; and so many parts of a Foot make a solid Foot of that piece of Stone or Timber.

PROP. 5.

To divide a Right Line into any number of Equal Parts, at the first opening of the Compass.

Let

the la
parts

Cen-
n 4.
the
the
ce
ill
nd
o-
or

Let a Line be given you to be di-
vided into 6 equal parts : Take the
length of the Line given in your Com-
passes ; then because it is to be divi-
ded into 6 parts, put one Foot in 6
on one Leg, and open the other Leg
till the other point fall on 6 on the o-
ther Leg: The Rule thus standing,
take the distance between 1 and 1,
that distance shall divide your given
Line into 6 equal parts : The like for
any other number of parts whatsoever.

Many other Conclusions may be
done by this Line ; but I shall re-
serve them, and divers other Con-
clusions of the like nature, to a
more convenient place.

THE

The Use of the
LINE of PROPORTION
IMPROVED.

By which

Board, Glass, Land, Wainscot,
Hangings, Pavement, Brick-
work, Tyling, Plaistering,
and any other Superficial ;

As Also,

Stone, Timber, *and other* Solid
Measure ; *may be Measured
thereby, without the use of* Pen,
Inke, Paper, Compasses, *or
other* Motion (*as sliding, or the
like*) *whatsoever, by* Inspecti-
on, *only by looking upon the*
Line.

The ARGUMENT.

I Am not ignorant how many have
written of the Use of this Line of
Pro-

Proportion since the invention of Logarithms, from which Tables this Line is constituted and made; as namely, After Mr. *Gunter*'s first contrivance, Mr. *Wingate* seconded him in making divers Lines to several Radiuses, thereby to bring it to extract the Square and Cube Roots without doubling or trebling, or dividing the distance into two or three parts; but this made a great number of Lines to small purpose; for nothing here could be done without the help of the Compasses.

Again, One *T. Browne*, a Maker of Mathematical Instruments, made it in a Serpentine or Spiral Line, composed of divers Consentrick Circles, thereby to enlarge the divisions; which was the contrivance of one Mr. ——— *Milburn* a *York-stire* Gentleman, who writ thereof, and communicated his Uses to the aforesaid *Brown*, who (since his death) attributed it to himself:

G 4

felf: But who-ever was the contriver of it, it is not without inconvenience; for it can in no wife be made portable; and befides (inftead of Compaffes) an opening Joynt with thirds muft be placed to move upon the centre of the Inftrument, without which no proportion can be wrought.

There is yet a third way contrived, by which this Line is made very ferviceable, and convenient both for ufe and carriage, and is to be ufed without Compaffes and is compofed of two Lines of one length upon either fide of two Rulers, to flide one by the fide of the other ; the ufes whereof in the meafuring of *Board*, *Glafs*, *Timber*, *Stone*, &c. and in other parts of *Geometry*, *Aftronomy*, *Fortification*, *Trigonometry*, *Geography*, *Navigation*, *Gauging*, *Dialling*, &c. together with the ufes of the Lines of Artificial *Sines* and *Tangents*, in the fame manner contrived, all upon one
Ruler,

triver
ence,
able;
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Ruler, are largely written upon by Mr. *Seth Partridge*, in a Book of his lately published, entituled, *The Description and Use of the Double Scale of Proportion*; which Book and Instrument are both sold by Mr. *Walter Hayes*, at the Sign of the *Cross-Daggers* in *Moor-fields*, neer the *Popeshead* Tavern.

There is yet another way of disposing of this Line of Proportion, by having one Line of the full length of the Ruler, and another Line of the same Radius broken in two parts between 3 and 4; so that in working your Compasses never go off of the Line: This is one of the best contrivances, but here Compasses must be used.
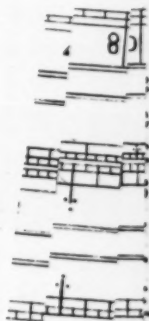
These are all the Contrivances that I have hitherto seen of these Lines: That which I here speak of, and will shew how to use, is only two Lines of one and the same Radius, being set

G 5   upon

upon a plain Ruler of any length (the
larger the better) having the begin-
ning of one Line, at the end of the
other, the divisions of each Line be-
ing set so close together, that if you
finde any number upon one of the
Lines, you may easily see what num-
ber stands against it in the other Line.
This is all the Variation : and what
this easie contrivance will effect, will
appear by the uses following.

The Lines are the same with the
Line of Proportion or Numbers, men-
tioned and treated of in the former
part of this Book ; and therefore how
to number upon them is shewed in
the first Chapter of this Book; and
therefore needs not here again be re-
peated. Also *Multiplication, Divi-
sion,* the *Golden Rule, Duplicated* and
Triplicated Proportion, the *Extracti-
on of Roots,* &c. delivered in the se-
cond, third, fourth, fifth Chapters, &c.
as also in Measuring of *Superficies* and
Solids,

Solids, and the menfuration of other
Figures treated of through the whole
Book, thefe Lines thus difpofed will
~~~~~~~~~~~~~~ But fome of

Solids, and the mensuration of other Figures treated of through the whole Book, these Lines thus disposed will effect with Compasses: But some of those Uses which they will effect in measuring without the help of Compasses, I will here shew.

The Figure of the Rule.
CAUTION.

What measure soever you measure by, let the Integer or grand Measure be divided into 10 or 100 parts (it matters not of what length your Lines of Proportion be, for to them all measures are alike.)   Thus, If you measure any thing by the Foot, let your Foot be divided into 100 parts: If by the Yard, divide your Yard into 100 parts: If by the Ell, divide that into 100 parts. So likewise, if by the Perch, Square, &c. or by what Measure soever, let the grand Measure (as I said before) be divided into 100 parts.

CHAP.

CHAP. I.

OF

SUPERFICIAL MEASURE.

BY Superficial Measure is meant all kind of flat Measure, such as is *Board*, *Glass*, *Pavement*, *Hangings*, *Plaistering*, *Tyling*, *Land-measures*, *&c.* And these several things are measured by distinct Measures, as some by the Foot, others by the Yard, others again by the Ell, some by the Rod, and some by the Square : of all which I shall give Examples : and,

I. Of FOOT-MEASURE.

Example 1. *If a Board be 1 Foot*

64 *parts broad ; how much in*
length of *that Board will make a*
Foot Square ?

Look upon one of your Lines (it
matters not which) for 1 Foot 64
parts, and right against it on the other
Line you shall finde 61 : and so ma-
ny parts of a Foot will make a Foot
square of that Board.

Example 2. *A Plank is 3 Foot 50*
parts broad ; how much thereof
in length will make a Foot ?

Finde 3 Foot 50 parts upon one
Line, and right against it on the other
Line you shall finde 28 parts and $\frac{4}{7}$ or
something more than half a part.

Example 3. *If a Board be 75 parts*
of a Foot broad ? how much
thereof in length shall make a
Foot square ?

Look

Look upon one of your Lines for 75, and right againſt it you ſhall finde 1 Foot, and 33 parts ; and ſo much in length makes a ſquare Foot.

Note. If the bredth of any thing given be more than one Foot, then the length of a Foot ſquare muſt be leſs than a Foot, as in the two firſt Examples it was : But if the bredth given be leſs than a Foot, (as in this laſt Example) then the length of a Foot ſquare muſt be more than a Foot.

Example 4. *A Pane of Glaſs is 35 parts broad; how much in length makes a Foot ?*

Finde 35 in one Line, againſt it you ſhall finde 2 Foot 85$\frac{4}{7}$ parts ; and ſo much in length makes a ſquare Foot.

Example

Example 5. *A Pane of Glass is 3 Foot broad; how much in length makes a Foot?*

...de 3 Foot in one Line, against ...he other you shall finde 33⅓ ...and so much in length makes a ...quare.

...mple 6. *If a piece of Glass be ...Foot 98 parts broad; how much ...length will make a Foot?*

...ok 1 Foot 98 parts in one Line, ...ainst it in the other you will ...;o Parts and half a part, and so ...in length makes a Foot.

... Of *YARD-MEASURE.*

...ample 1. *A Gallery is Wainsco- ...d 2 Yards 56 parts deep; how ...much of that length will make a Yard square?*

Seek

Look upon one of your Lines for 75, and right againſt it you ſhall finde 1 Foot, and 33 parts ; and ſo much in length makes a ſquare Foot.

> *Note.* If the bredth of any given be more than one then the length of a Foot muſt be leſs than a Foot, as two firſt Examples it was : the bredth given be leſs t Foot, (as in this laſt Exaꝛ then the length of a Foot ꝛ muſt be more than a Foo

Example 4. *A Pane of Gꝛ 35 parts broad ; how mꜳ length makes a Foot ?*

Finde 35 in one Line, agaiꝛ you ſhall finde 2 Foot 85⁴⁄₇ p and ſo much in length makes a ꝼ Foot.

Example

Example 5. *A Pane of Glass is 3*
Foot broad; how much in length
makes a Foot?

Finde 3 Foot in one Line, against
it in the other you shall finde $33\frac{1}{3}$
parts, and so much in length makes a
Foot square.

Example 6. *If a piece of Glass be*
1 Foot 98 parts broad; how much
in length will make a Foot?

Look 1 Foot 98 parts in one Line,
and against it in the other you will
finde 50 Parts and half a part, and so
much in length makes a Foot.

II. Of YARD-MEASURE.

Example 1. *A Gallery is Wainsco-*
ted 2 Yards 56 parts deep; how
much of that length will make a
Yard square?

Seek

Seek 2 Yards 56 parts in one Line, and against it in the other you shall finde 39 parts and somewhat more; and so many parts of a Yard will make a Yard square.

> Example 2. *A Room is Wainscoted 1 Yard 13 parts high; how much in length thereof will make a Yard square?*

Look one Yard 13 parts in one Line, against it in the other you will finde 88 parts, and above half a part; and so much in length makes a Yard square.

> Example 3. *If the Friezs about a Room be 62 parts of a Yard broad; how much in length thereof will make a Yard square?*

Finde 62 parts in one of your Lines,

Lines, and againſt it in the other you
ſhall finde 1 Yard 61 parts, and ſome-
what more ; and ſo much in length
makes a Foot ſquare.

> Example 4. *There is a Gallery pa-*
> *ved with Marble, being 5 Yards*
> *70 parts broad ; how much of that*
> *in length will make a Yard*
> *Square ?*

Seek 5 Yards 70 parts in one Line,
and againſt it in the other you ſhall
finde 17 parts and an half ; and ſo
much in length of that Pavement will
make a Yard ſquare.

> Example 5. *A Parlour being 7*
> *Yards 29 parts broad, hath a*
> *Cieling of Fret-work plaiſtered ;*
> *how much of that bredth will make*
> *a Yard Square ?*

Finde 7 Yards 29 parts in one of
your

your Lines, and right againſt it in the
other Line you ſhall finde 13 parts
and $\frac{7}{10}$, which is above half a part :
So that 13 parts and a little more than
half a part, will make a Yard ſquare
of that Cieling.

> Example 6. *A Plaiſterer hath Ren-*
> *dred the inſide of a Wall con-*
> *taining* 2 *Yards* 36 *parts in*
> *height ; how much of that will*
> *make a Yard ſquare ?*

Finde 2 Yards 36 parts in one of
your Lines, and right againſt it on the
other you ſhall finde 42 parts $\frac{1}{10}$ of a
part, that is ſomething more than one
third part of a part ; and ſo much in
length makes a Yard Square.

III. Of MEASURE by the ELL.

> Example 1. *There is a Room hung*
> *with Tapeſtry , which is* 4 *Ells*

25

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25 parts high; how much Ta-
pestry in length will make an Ell
square?

Note. Here by Ells we understand
Flemish Ells (for by that Mea-
sure are Hangings sold;) which
Ell contains three quarters of our
Yard; that is 75 parts of our
Yard: So that if an Upholster
have his Flemish Ell divided into
100 parts, he may measure his
Hangings as in the Examples
following is shewed.

Here because the Hangings are 4
Ells 25 parts deep, Look for 4 Ells
25 parts in one of your Lines, right
against which in the other you shall
finde 23 parts and a half; and so ma-
ny parts of his Ell will make a Fle-
mish Ell square.

Example 2. *The Embroidery of a*
pair

pair of Vallens about a Bed is 28
parts of a Flemish Ell deep;
how much of that Embroidery in
length will make a Flemish Ell
square?

Look for 28 parts in one of your
Lines, and against it in the other Line
you shall finde 3 Ells and 57 parts of
an Ell; and so much in length will
make an Ell square.

Example 3. *A Gallery being 3 Ells*
98 parts deep, is hung with Ar-
ras; how much of that depth will
make an Ell square?

Seek Ells 98 parts in one Line
against which in the other you shall
25 yards and $\frac{1}{10}$ of a part; and so
much in length will make an Ell
square,

IV. Of

IV. Of MEASURE by the ROD.

Example 1. *There is a Brick-wall
which is 75 parts of a Rod high;
how much in length of that Wall
will make a Rod square?*

Note, That all Wall-work is by
the Bricklayers meafured by the
Rod, which contains 16 Foot
and a half in length : Where-
fore, let his Rod, being 16 foot
and an half in length, be divi-
ded into 100 equal parts, and
then let him work as followeth.

The Wall being 75 parts of a Rod
high, Look for 75 parts in one Line,
and in the other Line right againft 75
you fhall finde 1 Rod 33 parts of a
Rod ; and fo much of that Wall in
length is contained in a Square Rod.

Example

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Example 2. *A Carpenter hath Rail'd and Paled in a Garden with Pales 52 parts of a Rod high, how much of that Paling shall make a Rod square?*

Seek 52 parts in one Line, against it in the other Line you shall finde 1 Rod 92 parts; and so much in length will make a Rod square of that Paling.

Example 3. *A Bricklayer hath made a Sewer to carry Water, the Bottom, Sides, and Arch together contains 1 Rod 64 parts; how much of that Drain or Sewer makes a Square Rod?*

Finde 1 Rod 64 parts in one of your Lines, and right against that number you shall finde in the other Line almost 61 parts; and so many parts of a Rod in length will make a Rod square. And

And here note, That though I have here put these two last Examples, that Paling is not measured by the Square Rod, but (let the height thereof be what it will) it is measured by the Rod in length. In like manner is Hedging, Ditching, and many other things that are measured by the Rod.

Example 4. *If a piece of Land be 2 Rod 31 parts broad; how much in length thereof shall make a Rod square?*

Seek 2 Rods 31 parts upon one of your Lines, and over against it upon the other Line you shall finde 42 parts and about $\frac{1}{3}$ of a part; and so much in length makes a square Rod.

Example 5. *A piece of Land being 80 parts of a Rod broad,*
                                                  how

how much thereof in length shal.
make a Rod square?

Look for 80 parts in one Line, and
in the other Line opposite thereunto
you shall finde 1 Rod 25 parts, and so
much in length makes a Rod square.

V. Of *MEASURING* by the *SQUARE.*

There are two things principally
which are measured by the Square,
and they are Tyling of Houses, and
Flooring of Rooms; and in this rec-
koning they account a Square to be 10
Foot every way : So that for this kind
of Measure divide a Line or Rod of
ten Foot long into 100 parts, and it
is fit for the purpose.

Example 1. *A Barn, the bredth*
of the Tyling whereof on both
sides is 1 *Square* 30 *parts ; how*
much

much in length of that Tyling
will make a Square Square?

Find 1 Square 30 parts upon one
of your Lines, and right against it on
the other Line you shall find 77
parts almost, and so much in length
of that Tyling will make a Square
Square.

Example 2. *The Tyling of a house*
is 76 parts of a Square broad,
how much in length thereof will
make a Square Square?

Seek 76 parts in one Line, and
against it in the other you shall find
1 Square 31 parts and an half almost;
and so much in length will mrke a
Square Square, that is, 10 Foot every
way, in all 100 Foot.

H   CHAP.

CHAP. II.

OF

SOLID MEASURE.

BY Solid Measure is meant such Measure as hath Length, Bredth, and Thickness, such as Timber, Stone, or the like. But before Timber or Stone can be measured, you must find the content of the square of the base thereof, which is taught by the Problem at the end of the Tenth Chapter. but that being performed by Compasses, I will here shew how it may be (by these Lines thus disposed) performed without; and that shall be my first Proposition or Example.

    Example 1. *Let a piece of Timber*
        or a Stone be 80 *parts of a Foot*
        deep, and 3 *Foot* 75 *parts broad;*
                      how

how much in length of that piece
will make a foot square ?

Here (by any of the former Rules
of Superficial Measure) find at 80
parts broad how much in length will
make a Foot, which you shall find to be
1 Foot 25 parts : For,

If you find 80 parts, the depth of
the piece, in one Line, against it in
the other you shall find 1 Foot 25
parts. Take 1 foot 25 parts out of your
Foot Rule, and measure it along the
bredth of the piece, which is 3 Foot
75 parts, and see how often it is con-
tained therein, which you shall find
to be 3 times ; wherefore, you may
conclude, that the square of the base of
that piece of Timber whose depth is
80 parts, and whose bredth is 3 Foot
75 parts, is just 3 Foot.

Now the square of the base of the
piece being thus obtained, you may
find the length of a Foot square there-
of in this manner.

Example 2. *Let the Square of the base of a piece of Timber or Stone be 3 foot, how much in length of that piece will make a foot solid ?*

Look for 3 Foot in one of your Lines, and in the other right against it you shall find 33 parts and ⅓ part of a part ; and so much in length will make a Foot solid.

Example 3. *Let a peice of Stone or Timber be 2 foot 50 parts broad, and 50 parts deep ; how much of that Stone in length shal make a solid foot ?*

By any of the wayes before prescribed you shall find that the depth of your Stone being 50 parts, it will require 2 Foot in length thereof to make a Foot square : Wherefore, measure how often you can find 2 Foot in the bredth of your Solid, which you may find only once, and 50 parts more,

which

which is one quarter of two h
Wherefore, the Square of this Soli
contains 1 Foot 25 parts. Wherefore,
Look in one of your Lines for 1 Foot
25 parts, right against it you shall find
80 parts ; and so much in length will
make a Foot solid.

> Example 4. *The Square of the*
> *Base of any regular Solid being*
> *given, together with the length of*
> *the same Solid, to find how many*
> *solid feet are contained in the*
> *same.*

Let the forementioned Solid serve
for this Example also, whose length was
35 Foot : We found that the Square
of the Base was 1 Foot 25 parts, and
that 80 parts in length would make
one solid Foot : Wherefore , take 80
parts of your Rule , and run it along
the piece so often as you can , which
you shall find to be 43 and 60 parts,
which is just three Quarters ; for that

in this piece of Timber there is 43
Foot and three Quarters.

I might add many more Examples of
this kind, and some to other pur-
poses; but these are sufficient for
what I here intended; and so I shall
conclude this Treatise, leaving the
farther practise thereof to your self:
For,

Usus optimus Magister,

CHAP. III.

OF

CIRCULAR MEASURE.

By having either the Circumfe-
rence *or* Diameter *of any* Cir-
cle *given, thereby to find the*
Side *of a* Square *Equal to the*
same

same Circle ; *or the Side of a*
Square *that may be inscribed*
within the same Circle.

IN the Thirteenth Chapter of this Book you have six Examples by having the Circumference or Diameter of any Circle given , thereby to find the Side of a Square equal to the Superficial Content, &c. But I have seen upon some Two-Foot-Rules Lines to effect this thing by only opening the Compasses to the distance given upon one Line , and applying the same to some of the other Scales. One of those Scales is noted at the end thereof with *C* , signifying the Circumference of any Circle ; the other with *D*, signifying the Diameter ; the other with *S. E* , signifying Square Equal to the Circle ; the other with *S. W*, signifying Square within.

Example. So that if you should have given you the Diameter of a Circle

being

being 15 Inches , Out of the Line
noted with *D* take 15 Inches , apply
that distance to the Line noted with
C, it will reach to 47 Inches and $\frac{11}{14}$
parts of an Inch; and so much is the
Circumference of that Circle.

Again , The Diameter being 15
Inches, as before, take that distance
out of the Line *D* , and it will reach
upon the Line *S E*, to 13 Inches $\frac{22}{24}$
parts ; and that shall be the Side of a
Square equal to the Circle whose Di-
ameter is 15 Inches.

Again , The Diameter being 15
Inches, if you take that distance out
of the line noted with *D*, it will reach
upon the Line *S W*. to 10 Inches $\frac{6}{7}$
parts of an Inch ; and that is the length
of the Side of the greatest Square that
can be drawn within that Circle whose
Diameter is 15 Inches.

The like may be done if the Cir-
cumference were given, by taking the
Circumference thereof out of the Line
noted

Line noted with C, and applying it to the
apply other Scales.
with
This I thought convenient to add
the here, because sometimes these Lines
are put upon Two-foot Rules.

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The CONCLUSION; or BRICK-LAYERS Supply.

WHereas Brick-work is al-
ways measured by the Rod
or Pole of 16 Foot and an half, mea-
sured upon the Superficies or outside
of the Wall or Building. And in single
Walls, and also in the sides of houses,
the Walls are of different thicknesses,
as from 1, to 10 or 20 bricks thick,
yet all there work in the mensuration
thereof is to be reduced to one set
Standard, namely, to one brick and half
in thickness, which to reduce is no
small trouble to the Brick-layer,
there being some difficulty therein. But
to

to render this also easie unto him, I
have added the following Proportions wo
of Walls one to another, And also a du
Proposition, shewing how by help of ex
your Line of Proportion or Numbers, po
Brick-work of any thickness is imme-
diately reduced to Brick and half.

Know therefore, That

A Wall of	1 Brick		3
	2 Bricks		4
	2 and half		5
	3 Bricks		6
	3 and half	Thick,	7
	4 Bricks	is in pro-	8
	4 and half	portion to	9
	5 Bricks	a wall 4,	10
	5 and half	One brick	11
	6 Bricks	& half	12
	6 and half	thick, as	13
	7 Bricks	3	14
	7 and half	is to	15
	8 Bricks		16
	8 and half		17
	9 Bricks		18
	9 and half		19
	10 Bricks		20

Having these Proportions, your work f.om any thickness will be reduced to Brick and half with ease and expedition, as by the following Propositions will be made to appear.

Prop.

If a Wall being 3 Bricks and an half thick, do contain 27 Rod upon the Superficies or outside thereof, how many Rod doth that Wall contain it being reduced to a Brick and half.

You see by the former Table that the Proportion between a Wall of a Brick and half, and a Wall of 3 Bricks and half, is in Proportion as 3 to 7. Wherefore, to work this upon your Line, do thus.

Take with your Compasses upon your Line the distance between 3 and 7. That same distance being set upon your Line at 27 (the number of Rods which your Wall contains)

will

will reach to 63, and so many Rod is
the e in that Wall it being reduced to
Brick and half. And so for any othea
thickness.

FINIS.